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ABSTRACT

Two different approaches to cost analysis (cross-sectional analysis and mock-school analysis) both indicate savings under the 45-15 year round school plan used in Loudoun County, Virginia. These methods of cost analysis were used to compare traditional school schedules with 45-15. One middle school and three elementary schools in Loudoun County functioned under a 45-15 plan for two years until new school construction could alleviate overcrowding. This report contains the results of the financial evaluation of that year-round plan, including an analysis of start-up costs. The analysis of cost-effectiveness revealed that savings are likely to be higher in 45-15 middle schools than at the elementary level. The major cost saving was in imputed rent (the translation of capital costs into the same framework as operating expenses). The magnitude of capital cost savings is related to the greater utilization of building space in the 45-15 plan. This report also reviews other 45-15 cost studies conducted for other school districts. In general, the findings of relative cost savings under 45-15 in the other studies is consistent with those reported for Loudoun County. (Author/DS)

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University of Virginia
The Colgate Darden Graduate School of Business Administration

45-15 COSTS

A Cost Study of Loudoun County's 45-15 Program

John L. Knapp, Steven W. Morris, and John S. Wright

Tayloe Murphy Institute

TAYLOE MURPHY INSTITUTE
P.O. Box 6550
University of Virginia
Charlottesville, Virginia 22906

C. Stewart Sheppard
Director
Dean, The Colgate Darden Graduate School
of Business Administration

Charles O. Meiburg
Executive Director
Professor of Business Administration

John L. Knapp
Research Director,
Economic Studies Center;
Associate Professor

Eleanor G. May
Research Director,
Business Studies Center;
Associate Professor of
Business Administration

William J. Serow
Research Director,
Population Studies Center;
Associate Professor

David C. Hodge
Economist

Julia H. Martin
Research Associate

Raoul J. Kister
Research Assistant

Barry A. Jackson
Illustrator

Kathryn M. Johnson
Librarian

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Although sound methodology was used for the analysis of the available data, error is always possible, and the authors accept total responsibility for the content of the report.

John L. Knapp, Research Director
Stephen W. Morris, Research Assistant
John S. Wright, Research Assistant

Economic Studies Center
Tayloe Murphy Institute

ABSTRACT

The Loudoun County 45-15 year-round program used in three elementary schools and one middle school in 1973-74 and 1974-75 resulted in per student cost savings in each year of operation. The annual savings varied considerably among schools and between years, but in general they amounted to 4.0-6.0 percent in the elementary schools and 7.0-9.0 percent in the middle school.

The major cost saving was in imputed rent--the technical term for the annual charge for capital including interest. Capital is composed of buildings and equipment that have a service life extending over many years. Imputed rent accounted for 64-75 percent of the savings at Sterling Middle School and 89-94 percent of the savings at Sterling Elementary School, the elementary school with midrange savings. The magnitude of capital cost savings is related to the greater utilization of building space in the 45-15 plan as compared with that in a traditional program.

There were several reasons for the higher savings at the middle school level than at the elementary level. First with many administrative personnel already on extended contract, additional days of service did not have to be purchased under 45-15. Second, teachers could opt for extended contracts, thereby saving additional fixed fringe benefit costs associated with employing new teachers. Third, 45-15 scheduling at the middle school promoted maximum usage of the middle school buildings.

Start-up costs associated with organizing, operating, and evaluating the 45-15 program totaled $474,626 for the four schools. This should be considered a high estimate since three-fourths of it was for air-conditioning two elementary schools not originally equipped. Guilford and Sully elementary schools were air-conditioned to make them suitable for year-round occupancy; however, the benefits provided by the new equipment did not cease with the termination of the 45-15 program.

Total annual cost savings of the 45-15 program depend on which year is considered and the bond period used to compute imputed rent. In 1973-74 total savings at the four schools were $280,769 under a 6 percent bond assumption for 20 years and $240,172 under a bond life of 30 years. In 1974-75 the comparable figures were $327,565 for a bond life of 20 years and $285,629 for one of 30 years. Even allowing for start-up costs of $64,502 annually spread over ten years, the total cost savings were substantial.

Most of the foregoing figures were from a mock-school analysis based on actual costs of the 45-15 schools and

hypothesized costs of a traditional program serving the same number of students. However, the study is not limited to this one form of analysis. A cross-sectional comparison was also made of the costs of traditional schools and those of 45-15 schools. That analysis indicated greater savings associated with 45-15 than did the mock-school analysis. However, most of this difference is explained by the fact that 45-15 schools were generally larger than the traditional schools, and they benefited from a size-cost advantage documented in the study.

Also reviewed were 45-15 cost studies for three other school systems--the Valley View School District, Romeoville, Illinois; the Virginia Beach Public Schools, Virginia Beach, Virginia; and the Prince William County Public Schools, Manassas, Virginia. Differences in results are evaluated, and in general the finding of relative cost savings under 45-15 in the other studies is consistent with those reported for Loudoun County.

CHAPTER 1

INTRODUCTION

Purpose of the Study

This study is a cost analysis of a year-round 45-15 attendance program in Loudoun County, Virginia. The special program involved one middle school and three elementary schools operated for two years, and ended June 30, 1975.

Loudoun County is a fast-growing suburban county in the Washington, D.C., metropolitan area. Faced with overcrowding in some of its schools, the county's only feasible options were 45-15 or double shifts. The county chose to convert 3 of its 18 elementary schools and 1 of its 3 middle schools to the 45-15 calendar. The schools selected were among the largest and most modern in the system. By the close of the 45-15 program, new school buildings had resolved the overcrowding difficulty.

Under a 45-15 schedule, pupils assigned to a school are separated into four groups. On any given school day only three of the groups attend the school; the other group is on vacation. The school calendar is arranged so that each group attends school for 45 days and then is on vacation for 15 days. Since one group is always on vacation, the school can accommodate a larger number of students than is possible under a traditional scheduling system. Theoretically, the enrollment can be expanded by 33 percent.

This study uses two approaches to evaluate costs of the 45-15 program. In the first approach, "the cross-sectional analysis", costs in the 45-15 schools are compared with those of county schools on a traditional schedule. In the second approach, "the mock-school analysis," costs of schools on a 45-15 schedule are compared with their costs had they been operated on a traditional schedule and expanded to serve the additional students. As an additional element of the analysis, "the start-up costs analysis," the one-time costs necessary to initiate the 45-15 plan are determined.

This study only analyzes costs incurred by the school division. It does not consider any changes in the quality of educational services, nor does it consider costs and benefits of the 45-15 schedule for pupils, parents, teachers, and administrators. Some of these issues have been addressed in other studies performed by or for the Loudoun County school administration.1/ Because of the limited scope of this study, there is no attempt to evaluate or extend these researches. However, these aspects of a 45-15 program should be considered in any comprehensive review of the merits of 45-15 scheduling.

Study Design and Data Collection

On July 17, 1975, a preliminary meeting between representatives of the Loudoun County Schools and the Tayloe Murphy Institute was held to discuss the feasibility of a cost analysis of the Loudoun County 45-15 program for the school years 1973-74 and 1974-75. The Tayloe Murphy Institute subsequently made a research proposal to the Loudoun County representatives, and it was accepted.

The research project was designed to include a comprehensive search of the literature on general cost-analysis techniques and cost studies of 45-15 programs. On the basis of the Institute's commitments to Loudoun, the best features of prior models, and the available data, specific models for the Loudoun study were constructed. The necessary data were then secured for statistical analysis.

Format of the Report

The body of the report is in five chapters. Chapter 2 reviews three previous studies of 45-15 programs. Chapter 3 presents a cross-sectional analysis with a review of the methodology and findings. Chapter 4 contains the mock-school case analysis with a review of the methodology and findings.

Chapter 5 presents the start-up costs analysis. Chapter 6 includes a comparison of the findings in the Loudoun County study and the findings in three previous studies of the 45-15 system, as well as conclusions of the Loudoun County study.

1/ See Planning Department, Loudoun County Schools, "Summary Report of the Study of Year-Round Education," Leesburg, January 1973; and "45-15 Status Report," Leesburg, November 1974; Ned S. Hubbel & Associates, Inc., "Attitudes toward Year-Round School in Loudoun County, Virginia" (Port Huron, Mich., April 1975).

CHAPTER 2

REVIEW OF OTHER STUDIES

Selected for review and comment in this chapter were cost analyses of 45-15 systems in the Valley View School District, Romeoville, Illinois; the Virginia Beach Public Schools, Virginia Beach, Virginia; and the Prince William County Public Schools, Manassas, Virginia.

Valley View

The design developed by the Illinois superintendent's office to measure costs of the Vallew View 45-15 plan used comparative-cost-per-pupil data to indicate system-wide cost changes after the introduction of the 45-15 plan.1/ To determine the costs of the district the following elements were used as cost assignment areas: administration, instruction, instructional support, institutional operations, services, transportation, capital outlay, and debt service. After cost data were deflated to 1968 dollars in terms of the consumer price index, the change in the cost per pupil between 1968-69 and 1969-70 (before the 45-15 plan) was compared with the change between 1969-70 and 1970-71. It should be noted that in this comparison only operating costs (which exclude capital outlay and debt service) were used. The study found a 7.5 percent increase between 1968-69 and 1969-70 compared to only a 3.6 percent increase between 1969-70 and 1970-71. (See table 2.1.) It was concluded that although there were no absolute dollar savings, the percentage increase in operating costs was reduced. Further analysis of the raw data revealed that even though teacher salary cost per pupil increased under 45-15, other

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1/ Illinois State Office of Superintendent of Public Instruction, The Cost of Educational Operation: The Traditional School Year vs. the Year-Round School (Springfield: Illinois State Office of Superintendent of Public Instruction, Division of Research, Planning, and Development, 1972), p. 3.

elements decreased and helped to offset the higher teacher costs. Decreased costs were noted in supplies and equipment; other instructional support costs; principals' salaries; guidance and counseling; and operations and maintenance.

TABLE 2.1

VALLEY VIEW OPERATING COSTS COMPARISONS, 1968-69 TO 1970-71

(1968 Dollars)

Operating Costs per Pupil			Percentage Change	
1968-69	1969-70	1970-71	1968-69 to 1969-70	1969-70 to 1970-71
$643.35	$691.72	$716.61	7.5	3.6

Source: Illinois State Office of Superintendent of Public Instruction, The Cost of Educational Operation: The Traditional School Year vs. The Year-Round School (Springfield: Illinois State Office of Superintendent of Public Instruction, Division of Research, Planning, and Development, 1972), pp. 11-12.

This study had certain limitations. The failure to include capital costs as part of the total cost per pupil was a serious omission. In addition, the price deflator used was not appropriate. The consumer price index is based on goods and services purchased by urban wage earners and clerical workers, and not on goods and services purchased by a school system. A more precise deflation could have been achieved by using changes in Valley View wages and salaries and specific price indexes for other types of outlays. Also clouding the results of the study were possible changes in cost totally unrelated to the introduction of the 45-15 plan. For example, there was no standardization method to control for changes in the pupil-teacher ratio.

In a related study prepared by the U.S. Department of Health, Education, and Welfare from materials written in part by the leadership of the Valley View School District, an estimate of costs under a 45-15 plan was made using 1969-70 costs

as a base.1/ The study hypothesized a 33 percent increase in enrollment over the 1969-70 figure of 5,580. Certain "conjectures" were used to approximate the costs under 45-15. Basic to these "conjectures" were the assumptions that certain costs vary with the number of pupils and with the number of days a school is open to students, and that certain costs are relatively fixed in any case. It was found that there would be a per pupil savings of $10.39, or 1.6 percent, in 45-15 current costs excluding transportation and capital outlay; per pupil savings were $32.96, or 4.1 percent, when comparing total costs. Table 2.2 is based on the estimates provided, with specific assumptions regarding the estimated costs in footnotes.

This analysis makes questionable assumptions and lacks empirical support. For example, a 33 percent increase in capacity is the projected enrollment even though this theoretical maximum is only attainable under ideal conditions. Also without supporting data, air-conditioning is assumed to cost less than heating.

Virginia Beach

The Institute for Social Analysis conducted a cost study of the 45-15 plan for the Virginia Beach City Public Schools in 1973-74.2/ The design compared the costs per pupil enrolled at elementary schools on the 45-15 plan with the cost for schools using traditional schedules. The cost per pupil in the 45-15 schools was $584.33, and the cost per pupil in traditional schools was $592.72. Even though the difference of $8.39, or 1.4 percent, in favor of the 45-15 schools was small, it represented a savings of approximately $38,510.3/ Instructional staff costs and support staff costs were based on the number of positions in each school multiplied by the division-wide average salary for each type of position. The large difference between instructional staff costs in 45-15 and traditional schools was due primarily to differences in pupil-teacher ratios. On the other hand, because support staffs served larger student bodies in the 45-15 schools, a per pupil support staff cost advantage occurred relative to the traditional schools.

1/ U.S. Department of Health, Education, and Welfare, National Center for Educational Communication, Year-Round Schools: The 45-15 Plan (Washington, D.C.: U.S. Government Printing Office, 1972). It should be noted that the figures in this study do not match those (for the same year) cited in the Illinois State study previously reviewed.

2/ Institute for Social Analysis, Cost Analysis 1973-74 (Virginia Beach, Va.: Virginia Beach Public Schools, 1974).

3/ Ibid., p. 1.

TABLE 2.2

VALLEY VIEW COST COMPARISONS, 1969-70

	Actual Traditional (Enrollment 5,530)		Estimated 45-15 (Enrollment 7,440) [a]	
	Total	Per Pupil	Total	Per Pupil
Administration	$ 208,000	$ 37.27	$ 238,000[b]	$ 31.98
Instruction	2,859,300	512.42	3,800,000[c]	510.75
Health	34,200	6.13	45,600	6.13
Operation	389,900	69.87	500,000[d]	67.20
Maintenance	34,100	6.11	40,000[e]	5.38
Fixed charges	163,200	29.25	217,600	29.25
Other (except food)	45,100	8.08	60,000	8.06
Current	3,733,800	669.14[f]	4,901,200	658.75
Transportation	296,400	53.12[f]	390,000[g]	52.42
Debt service[h]	488,400	87.63	488,400	65.85
Noncperating	784,800	140.65	878,400	118.06
Total	4,518,600	809.78	5,779,600	776.82
Exhibit:				
Capital outlay[i]	766,000	137.27	766,000	102.96

Source: U.S. Department of Health, Education, and Welfare, National Center for Educational Communications, Year-Round Schools: The 45-15 Plan (Washington, D.C.: U.S. Government Printing Office, 1972), p. 17.

Note: Information in the footnotes was taken directly from the source except for remarks in parentheses.

a/ Based on the hypothesis that 45-15 enrollment would be one-third greater than actual traditional enrollment.

b/ Assumes two additional administrators, one to help with scheduling.

c/ Assumes some savings in small equipment and materials.

d/ Assumes janitors work fewer hours during vacation periods.

e/ Assumes some increase in repairs but not proportionately.

f/ The sum of the current expenditures and transportation expenditures in this study should equal the operating costs in the previously cited Illinois State study. It does not.

g/ Assumes some savings in equipment, but this may be optimistic because extended routes may wipe out this difference.

h/ Actually interest would drop each year as principal is paid off.

i/ An expenditure but not chargeable because it is reflected already through debt service. (Note. This assumes that all capital outlay is handled through debt service.)

Instructional space costs were calculated with the following formula:

present cost of space x finance cost of space
÷ useful life of that space.1/

The researchers assumed that "finance costs would double the present cost of space and that the useful life of space is 30 years."2/ Maintenance and textbook rental costs were based on costs recorded by each elementary school in the district. The cost-per-pupil data used by the Institute included public information and special capital outlay costs related to the 45-15 program. While they should not be ignored, they perhaps should be considered as special start-up costs rather than as part of regular per pupil operation costs. Had these costs been excluded from the analysis, the percentage change would have been 3.7 percent rather than 1.4 percent. On the other hand, variables such as transportation were not included "because it was felt that the net impact would be insignificant and because insufficient records existed to permit capturing the unique transportation costs of the 45-15 schools and of the other elementary schools."3/ In table 2.3 the Virginia Beach cost comparisons are shown.

TABLE 2.3

VIRGINIA BEACH COST COMPARISONS, 1973-74

	Cost per Pupil		Difference between 45-15 and Traditional	
	Traditional Schools	45-15 Schools	Amount	% Change
Instructional staff	$ 315.84	$ 356.07	$ 40.23	12.7
Instructional space	45.01	39.33	- 5.68	-12.6
Support staff	159.00	116.00	-43.00	-27.0
Support space	51.87	36.77	-15.10	-29.1
Maintenance	9.20	7.11	- 2.09	-27.7
Textbook rental	11.80	15.24	3.44	29.1
Public information	...	10.89	10.89	a/
Capital outlay	...	2.92	2.92	a/
Total	592.72	584.33	- 8.39	- 1.4

Source: Institute for Social Analysis, Cost Analysis 1973-74 (Virginia Beach: Virginia Beach Public Schools, 1974), p. 2.

a/ Not applicable since these were start-up costs limited to 45-15 schools.

1/ Ibid., p. 3.

2/ Ibid.

3/ Ibid., p. 13.

In addition to the limitations in the Virginia Beach design already mentioned (treatment of special start-up costs and transportation), there are three other areas of concern. First, no account is taken of any differences in pupil-teacher ratio between the 45-15 schools (26.38:1) and the traditional schools (28.49:1). If lower pupil-teacher ratios are not inherent in 45-15, the higher pupil-teacher ratio in the traditional schools biases the findings in their favor, since costs are spread over proportionally more students. Second, contrary to what might be predicted, textbook rental costs were higher in 45-15 schools than in traditional schools. The $3.44 difference was explained as being a possible result of "added textbook inventory/distribution problems that would come with 45-15 scheduling."1/ However, logic dictates that cost per pupil should either remain constant or, through the rotation of books, decrease in 45-15 schools. This unexpected cost reduces the absolute and relative savings attributable to 45-15. Finally, several unsubstantiated assumptions were made regarding the development of imputed rents for capital costs. Although a building life of 30 years appears plausible, no reason is given for that assumption, nor is there any for the assumption that interest costs double the current cost of space.

Prince William

Education Turnkey Systems, Inc., completed a cost analysis of the 45-15 system in the school year 1971-72 for the Prince William County School Board.2/ The methodology required the determination of costs (cost per pupil enrolled) for a school on the 45-15 plan and mock costs for the same school had it continued on the traditional calendar. The 45-15 enrollment was assumed to be one-third greater than it would have been under traditional operation. Analyses were completed for both a secondary and an elementary school.

According to the researchers, the simulation of the secondary 45-15 school, Godwin Middle School, on a traditional calendar obviated the virtually impossible task of matching Godwin with another school. The COST-ED Model, the analytical tool developed, allocated and combined resource costs to determine the total costs for any given function (or program). A comparison of the projected traditional costs per pupil at Godwin ($1,143.06) with the actual 45-15 costs ($1,033.60) showed that savings of $109.46, or 9.6 percent, were accrued.3/ Actual projected savings by cost area are shown in table 2.4.

1/ Ibid., p. 13.

2/ Blair H. Curry and John M. Sweeney, 45-15 and the Cost of Education (Washington, D.C.: Educational Turnkey Systems, n.d.).

3/ Ibid., p. 18.

TABLE 2.4

PRINCE WILLIAM COST COMPARISONS FOR GODWIN MIDDLE SCHOOL, 1971-72

Resource	Cost per Pupil: Traditional Term Cost	Cost per Pupil: 45-15 Cost	Difference between 45-15 and Traditional: Amount	Difference between 45-15 and Traditional: % Change
Teachers	$ 503.04	$ 469.20	$-33.84	- 6.7
Aides	34.98	34.18	- .80	- 2.3
Classrooms	150.41	121.57	-28.84	-19.2
Classroom furnishings	32.55	27.80	- 4.75	-14.6
Audiovisual equipment	4.18	3.89	- .29	- 6.9
Books and audiovisual software	14.05	14.05	...	...
Gymnasium	51.71	41.83	- 9.88	-19.1
Gymnasium equipment	2.90	2.67	- .23	- 7.9
Cafeteria	26.81	21.69	- 5.12	-19.1
Cafeteria equipment	1.54	1.38	- .16	-10.4
Counselors	33.46	29.07	- 4.39	-13.1
Librarians	16.52	14.89	- 1.63	- 9.9
Library	12.90	10.41	- 2.49	-19.3
Library furnishings	3.22	2.84	- .38	-11.8
Offices	7.60	6.07	- 1.53	-20.1
Office furnishings	1.51	1.32	- .19	-12.6
Principal/asst. principals	44.27	35.08	- 9.19	-20.8
Support staff	31.40	25.65	- 5.75	-18.3
Buses	7.57	7.57	...	...
Dist. student support staff	2.05	2.05	...	...
Dist. instruc. support staff	24.78	24.78	...	...
Dist. administrative staff	23.94	23.94	...	...
Districtwide offices	6.77	6.77	...	...
Dist. office furnishings	3.74	3.74	...	...
Coaches	3.59	3.59	...	...
Misc. supplies & expenses	97.57	97.57	...	...
Total	1,143.06	1,033.60	109.46	9.6

Source: Blair H. Curry and John M. Sweeney, 45-15 and the Cost of Education (Washington, D.C.: Educational Turnkey Systems, n.d.),p. 18.

Using the COST-ED Model, elementary school costs of the traditional and the 45-15 plan were compared. The savings amounted to $46.27, or 5.3 percent.1/ A breakdown of the approximate effects of 45-15 on the cost of elementary programs is presented in table 2.5.

A major reason for the difference between savings in the two schools was the lack of extended teaching contracts at the elementary level. It was noted that some savings in the secondary school might be eroded by expected salary increases with increased student loads. However, it was pointed out that the county school program "would cost less under a well-planned 45-15 operation than a similar program run on a traditional-term basis" because of the noted "significant potential for savings."2/

There are a number of limitations to the Turnkey study. One is the assumption that the 45-15 enrollment is one-third higher than that with a mock traditional schedule. As previously stated, this is the theoretical maximum under ideal conditions, and it may not be attainable in all circumstances. Another limitation is the assignment of many central costs to all schools on a per pupil basis even though some costs were peculiar to elementary, middle, or high school students. Hence, per student district-wide costs may have been overstated for some levels and understated for others. Treatment of capital costs in this study was different from that in the Virginia Beach research. Rather than considering present school replacement costs, the cost of bonds (principal and interest) sold to construct the individual school was amortized over the useful life of the building. Likewise, furnishings and equipment costs were determined by amortizing the principal and interest over the life of the equipment during the useful life of the building. In addition, the useful life of a building was assumed to be 50 years; without any allowance for renovation, this appears unrealistic. According to Roberts and Lichtenburger, most school buildings require substantial rennovation after 15 to 25 years.3/ Further, interest payments for the life of the bond were apparently spread over the 50-year life of the building. This procedure ignores the increased interest payments needed to spread these costs over 50 years rather than over the bond life, and hence imputed rent would be biased downward.

1/ Ibid., pp. 39-42.

2/ Ibid., pp. 52-53.

3/ Charles T. Roberts and Allan R. Lichtenburger, eds., Financial Accounting: Classification and Standard Terminology for Local and State School Systems (Washington, D.C.: U.S. Government Printing Office, 1973), pp. 66-68.

TABLE 2.5

PRINCE WILLIAM COST COMPARISONS FOR NEABSCO, DALE CITY, AND BEL AIR ELEMENTARY SCHOOLS, 1971-72

Resource	Cost per Pupil		Difference between 45-15 and Traditional	
	Traditional Term Cost	45-15 Cost	Amount	% Change
Teachers	$430.89	$430.89	$ ...	...
Aides	13.32	13.02	- .30	- 2.3
Classrooms	88.28	71.31	-16.97	-19.2
Classroom furnishings	18.03	15.40	- 2.63	-14.6
Audiovisual equipment	4.18	3.89	- .29	- 6.9
Books and audiovisual software	14.05	14.05	...	...
Gymnasium	29.38	23.76	- 5.62	-19.1
Gymnasium equipment	1.61	1.48	- .13	- 8.1
Cafeteria	15.28	12.36	- 2.92	-19.1
Cafeteria equipment	.85	.76	- .09	-10.6
Librarians	14.24	12.84	- 1.40	- 9.8
Library	7.16	5.78	- 1.38	-19.3
Library furnishings	1.78	1.57	- .21	-11.8
Offices	4.22	3.37	- .85	-20.1
Office furnishings	.84	.73	- .11	-13.1
Principal/asst. principals	40.47	32.07	- 8.40	-20.8
Support staff	27.14	22.17	- 4.97	-18.3
Buses	7.57	7.57	...	...
Dist. student support staff	2.05	2.05	...	...
Dist. instruc. support staff	24.78	24.78	...	...
Dist. administrative staff	23.94	23.94	...	...
Districtwide offices	6.77	6.77	...	...
Dist. office furnishings	3.74	3.74	...	...
Misc. supplies & expenses	97.57	97.57	...	...
Total	878.14	831.87	46.27	5.3

Source: Blair H. Curry and John M. Sweeney, 45-15 and the Cost of Education (Washington, D.C.: Educational Turnkey Systems, n.d.), p. 37.

Regarding utility costs, a basic assumption was that "it costs about twice as much to heat a building for a month as it does to cool it for a month." 1/ This assumption was apparently derived from an analysis of utility costs incurred by county schools.2/ However, the exact procedure for determining the estimate was not explained.

1/ Curry and Sweeney, 45-15 and the Cost of Education, p. 26.

2/ According to a telephone conversation with Mr. Charles Blaschke, Education Turnkey Systems, Inc., February 5, 1976.

CHAPTER 3

CROSS-SECTIONAL ANALYSIS

The first section of this chapter is a report of the annual operating expenses for the 18 elementary and 3 middle schools in Loudoun County. A method for deriving annual capital costs is then described, and in a third section the data from these two sections are combined to provide a cross-sectional comparison of costs between traditional and 45-15 schools.

Operating Costs

Operating costs are incurred annually and tend to vary with the number of pupils. Since capital costs for buildings and equipment are excluded, operating costs do not represent the total cost of educating a child at each school. Although capital costs should be integrated into the analysis in order to make valid total per student cost comparisons between different facilities, operating costs alone provide valuable information. For example, maintenance, heating, and other operating expenses for an old building may be so high that construction of a new facility would save money. This would be true if the difference between operating expenses for the old facility and for a comparable new facility were greater than the annualized cost of constructing the new facility. Since any debt on the old facility is already committed, the decision would be based entirely on operating costs. The approach to operating costs developed in this section should prove useful for school administrators.

Operating costs are aggregated into seven categories. (Details of cost assignments are provided in the appendix on methodology.)

1. Administration at the school level-- Local school administration costs including salaries of principal, assistant principals, deans, counselors, school nurse, and school secretaries.

2. Instruction-- Salaries of teachers, librarian, and library clerk.

3. Instructional costs other than salaries-- Instructional supplies and books as well as other miscellaneous expenses for school items.

4. Utilities and fuel

5. Maintenance-- Custodial salaries, supplies, and other school specific maintenance costs.

6. Elementary (middle) school overhead--Costs incurred relating to the operation of all elementary (middle) schools; for example, since the elementary physical education program is operated division-wide, these costs are summed and divided by total division elementary average daily membership (ADM)-- multiplication of this amount by a school's ADM results in a product equaling the school's share of this elementary level special program.

7. Division-wide overhead-- Costs incurred at a division-wide level that cover activities not specific to any one cost center or group of cost centers; includes high-level administrative salaries and certain costs that could not be traced to the school level; transportation costs and certain types of maintenance personnel costs are examples-- division-wide overhead costs are summed for the division and allocated on an ADM basis.

To insure the validity of cost comparisons made with this information, certain differences among schools are standardized. Two procedures are used. First, salaries for all personnel are standardized for educational achievement and experience since salary differentials do not reflect real cost differences among schools. Such differentials represent random fluctuations in the assignment of experienced or higher educated teachers and/or a growth pattern in which older areas tend to have more experienced school employees. Accordingly, salary differentials between old and new schools do not reflect savings in some facilities, but rather an uneven distribution of experienced employees among county schools. Standardizing these salaries eliminates one source of cost variation, and other factors causing variation in school costs can be identified.

Standardization for class size also seems indicated. Since instructional salaries account for approximately 50 percent of Loudoun County's total educational expenditure, class size is a major determinant of per student educational cost. A 10 percent increase in class size would reduce per pupil costs by

5 percent. Unless cost figures are adjusted for differences in class size, comparisons of per school costs are clouded by this strong class size-cost relationship. However, in some instances class size differentials may be fixed by the size of the facility or the school's calendar (traditional or 45-15). In such cases, the cost differences related to class-size differentials represent real cost differences.

School size may be directly related to variability in class size. For example, assume that in two schools, one with a population of 250 in the fourth grade and the other with 50, the administrator desires a class size of 20 in each fourth grade. In the small school he can achieve an average class size of 25 by hiring 2 teachers, or an average class size of 17 by hiring 3 teachers. The larger school would have the following options in the class-size range between 17 and 25.

Number of Teachers	Average Class Size for a 4th Grade Population of 250
10	25
11	23
12	21
13	19
14	18
15	17

Since a greater latitude for reaching the desired goal in terms of class size exists in the larger school, the variability of class size around the goal will be higher for a smaller school, because of fewer planning options. The small school could have a class size of either 17 or 25, whereas the large school would have these options plus four others in between. Variability in class size and a school's calendar are also related. Year-round scheduling decreases class-size planning options and results in higher variability in class size.

To relate class size either to a facility size or to a school's calendar requires an assumption with respect to administrative policy. If the administration is aiming at a class-size target, but is indifferent to either overshooting or undershooting it, then no problem exists. However, if in scheduling the administration regards a certain class-size target as a maximum, then a relationship between class size and school size (or calendar) becomes relevant. Assuming the administration desires a class size of 20 and refuses to go higher, the small school would have only one option, and that would be a size of 17. In contrast, the large school would have three options (17, 18, and 19) and could choose the more cost-efficient class size of 19.

Similarly, in staffing the four separate attendance groups for each grade level in a 45-15 school, the administration has fewer options in choosing the number of teachers for each grade.

There is no unequivocal answer to the class-size-standardization problem. In Loudoun County 45-15 did result in smaller class sizes. However, the difference between the 45-15 average class size and the overall average class size was not large.1/ Since these schools formerly had relatively large classes, a specific administration goal may have been to reduce average class size in this part of the county. Therefore, analysis of the Loudoun County data does not provide a definite answer to the class-size-standardization question.

In this study a class-size adjustment factor was determined so that actual figures and standardized figures could be compared.2/ The adjustment factor may be interpreted in the following manner. If the teaching staff in the school were adjusted to the level (usually a fractional number of teachers) required for a standard class size, then the per student increase (or decrease) in costs due to the increase (or decrease) in instructional salaries would equal the class-size adjustment factor. In schools with smaller than the standard class size, the factor would be negative. In those with larger than standard class size it would be positive. Noninstructional costs remain unchanged since it is assumed that the current facility can accommodate the new instructional positions. The standard class-size figures were:3/

Elementary school	23.51
Middle school	19.21

An example will clarify the analytic procedure. Arcola Elementary School (E.S.) in 1973-74 had an average daily

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1/ The simple average elementary school class size over the two years was 23.51. For the 45-15 elementary schools the average class size was 23.08, and the range was from 22.17 to 25.24.

2/ Technically, class-size in the middle school is higher than the pupil-teacher ratio because teachers have planning periods in the semidepartmentalized organization; for the purpose of this study, the class size is defined as equal to the pupil-teacher ratio at each school.

3/ The function of the class-size adjustment factor was to facilitate comparisons between schools with different class sizes. Therefore the "rule" for comparison is somewhat arbitrary. In this study, the approximate class-size averages over the two years of the project were used as the standard class-size figures.

membership (ADM) of 195.18. With 10 teachers, the class size was 19.52. For this school to have an average class size of 23.51, 8.30 teachers would be required, 1.7 fewer than the actual case. Thus the instructional costs of 1.7 teachers are divided by ADM and expressed as a per student class-size adjustment factor. In this example the factor is $-82.59, indicating that unadjusted costs are high because of the small class size. It should be stressed that it would be impossible to employ a fractional number of teachers unless their time were shared among schools. In addition, the procedure ignores the problem of assigning teachers by grade level and other real-world scheduling difficulties. Although the class-size adjustment factor is theoretical and in no way implies what a pupil-teacher ratio should be for any school, it is required in a cross-sectional study if costs among schools are to be compared.

Operating costs for all schools in 1973-74 are shown in table 3.1. Operating costs per student for the traditional elementary schools ranged from $1,079.95 at Middleburg to $892.48 at Lovettsville. Middleburg represented the smallest school in 1973-74 with an ADM of 111.00; Catoctin, which was the largest school with an ADM of 536.35, had one of the lowest operating costs ($897.81 per student).

All 45-15 schools had operating costs 1.6-5.5 percent lower than those for Lovettsville. However, since rated ADM in each of these schools equaled or exceeded ADM in the traditional schools, these differentials cannot without qualification be attributed to the difference in school-year calendars. This point will be discussed under Cross-Sectional Comparison later in the chapter.

Operating costs for all schools in 1974-75 are shown in table 3.2. In 1974-75 the range of cost per student at the traditional elementary schools was from $1,278.67 at Aldie E.S. to $961.82 at Catoctin E.S. Again the size-cost relation is evident in those figures as Aldie represents the smallest elementary program with an ADM of 94.00 and Catoctin the largest with an ADM of 579.99. The 45-15 schools had operating costs 2.5-4.5 percent lower than those at Catoctin.

Operating costs for middle schools are also shown in tables 3.1 and 3.2, and the same inferences made as from those for elementary schools.

Capital Costs

Capital costs represent large outlays for buildings and equipment that can be used over many years. To estimate the annual cost of capital, an imputed rent, or an annual charge for capital, is calculated.

Capital costs are one-time fixed costs, whereas operating expenses are annual costs representing a continuous flow of

TABLE 3.1

OPERATING COSTS PER ADM OF LOUDOUN COUNTY ELEMENTARY AND MIDDLE SCHOOLS, 1973-74

Line	Type of School and ADM	Administration at School	Instructional Salaries	Instructional Costs Other Than Salaries	Utilities and Fuel
	Traditional elementary				
1	Aldie (184.63)	$ 100.10	$ 488.66	$ 12.21	$ 45.25
2	Arcola (195.18)	94.69	523.16	11.49	30.02
3	Ashburn (143.22)	129.04	494.42	11.42	39.19
4	Banneker (148.22)	124.69	557.92	11.90	36.14
5	Catoctin (536.35)	38.33	441.24	16.27	14.23
6	Douglass (264.89)	69.77	502.56	13.48	34.26
7	Emerick (252.86)	73.09	407.06	10.79	41.95
8	Hamilton (171.69)	107.64	469.18[a/]	11.41	50.42
9	Hillsboro (117.26)	157.61	437.78	13.30	31.76
10	Lincoln (170.96)	108.10	460.33	11.27	22.99
11	Lovettsville (254.34)	72.66	404.78	10.04	30.16
12	Lucketts (157.00)	117.71	386.83	15.21	42.75
13	Middleburg (111.00)	166.50	547.10	12.25	64.54
14	Round Hill (235.62)	78.44	435.81	9.01	38.47
15	Waterford (109.22)	169.21	468.97	11.74	47.53
	45-15 elementary				
16	Guilford (578.69)	69.54	433.97[a/]	11.62	26.92
17	Sterling (835.87)	48.12	432.23[a/]	10.38	33.91
18	Sully (840.33)	47.78	391.80[a/]	10.37	20.76
	Traditional middle				
19	Blue Ridge (958.24)	159.70	456.66	22.52	30.96
20	Leesburg (513.60)	206.45	510.77	33.55	22.96
	45-15 middle				
21	Sterling (1,389.36)	122.56	468.39	26.46	20.72

Note: Details may not add to totals due to rounding.

a/ Expenditure for teacher aides is not included in the instructional salaries figure. These expenditures were small in most of the schools; in fact, a majority of schools did not even use teacher aides. In those schools with significant expenditures for teacher aides, they were a result of overcrowded conditions and the class size adjustment factor accounts for this.

Table 3.1 (Continued)

Maintenance	Elementary (Middle) School Overhead	Division-wide Overhead	Total Operating Cost	Class-Size Adjustment Factor	Adjusted Total Operating Cost	Line
$ 38.98	$ 103.96	$ 212.03	$1,005.18	$- 59.06	$ 946.12	1
36.31	103.96	212.03	1,011.65	- 82.59	929.06	2
51.05	103.96	212.03	1,041.11	- 53.63	987.48	3
65.76	103.96	212.03	1,112.41	-108.76	1,003.65	4
15.00	103.96	212.03	841.06	56.25	897.81	5
27.45	103.96	212.03	963.52	- 61.93	901.99	6
32.67	103.96	212.03	881.55	28.52	910.07	7
41.92	103.96	212.03	996.58	- 38.66	957.92	8
60.30	103.96	212.03	1,016.75	- 0.81	1,015.94	9
42.53	103.96	212.03	961.21	- 31.06	929.59	10
28.28	103.96	212.03	861.91	30.57	892.48	11
48.82	103.96	212.03	927.32	41.07	968.38	12
82.92	103.96	212.03	1,189.30	-109.35	1,079.95	13
31.51	103.96	212.03	909.22	0.80	910.02	14
65.31	103.96	212.03	1,078.74	- 30.39	1,048.35	15
26.49	103.96	212.03	884.54	- 6.39	878.15	16
15.06	103.96	212.03	855.68	- 12.37	843.31	17
18.13	103.96	212.03	804.83	27.65	832.48	18
34.29	21.74	212.03	937.92	17.31	955.23	19
38.35	21.74	212.03	1,045.85	- 21.65	1,024.20	20
27.05	21.74	212.03	898.95	- 2.86	896.09	21

TABLE 3.2

OPERATING COST PER ADM OF LOUDOUN COUNTY ELEMENTARY AND MIDDLE SCHOOLS, 1974-75

Line	Type of School and ADM	Administration at School	Instructional Salaries	Instructional Costs Other Than Salaries	Utilities and Fuel
	Traditional elementary				
1	Aldie (94.00)	$ 219.00	$ 588.33	$ 19.99	$ 129.27
2	Arcola (252.22)	91.05	442.26	12.71	72.86
3	Ashburn (143.00)	143.96	463.94	13.50	50.82
4	Banneker (139.68)	147.25	491.18[a]	13.80	85.41
5	Catoctin (579.99)	70.03	387.00	13.88	48.65
6	Douglass (287.00)	71.73	466.72	9.70	37.14
7	Emerick (299.33)	68.77	447.49	12.60	43.25
8	Hamilton (174.20)	118.18	501.98	14.21	60.43
9	Hillsboro (114.49)	179.81	485.66	14.69	97.26
10	Lincoln (174.47)	117.99	501.23	14.44	39.82
11	Lovettsville (251.56)	91.28	443.38	13.20	74.14
12	Lucketts (156.00)	131.96	426.50	13.41	104.92
13	Middleburg (115.00)	179.01	483.57	13.70	51.43
14	Round Hill (226.31)	90.96	491.22	12.87	56.12
15	Waterford (126.59)	162.62	440.64[a]	13.64	50.61
	45-15 elementary				
16	Guilford (642.98)	70.06	467.56	13.68	48.08
17	Sterling (890.97)	50.52	469.45[a]	12.75	40.93
18	Sully (810.12)	55.43	458.33[a]	13.26	44.41
	Traditional middle				
19	Blue Ridge (946.75)	178.01	527.28	18.89	81.20
20	Leesburg (520.89)	223.93	582.26	18.88	33.30
	45-15 middle				
21	Sterling (1,534.40)	127.18	512.79	18.91	48.40

Note: Details may not add to totals due to rounding.

a/ Expenditure for teacher aides is not included in the instructional salaries figure. These expenditures were small in most of the schools; in fact, a majority of schools did not even use teacher aides. In those schools with significant expenditures for teacher aides, they were a result of overcrowded conditions and the class size adjustment factor accounts for this.

Table 3.2 (Continued)

Maintenance	Elementary (Middle) School Overhead	Division-wide Overhead	Total Operating Cost	Class-Size Adjustment Factor	Adjusted Total Operating Cost	Line
$ 96.61	$ 127.35	$ 207.93	$1,388.48	$-109.81	$1,278.67	1
49.01	127.35	207.93	1,003.16	29.88	1,033.04	2
88.84	127.35	207.93	1,096.34	5.77	1,102.11	3
93.03	127.35	207.93	1,165.96	- 4.43	1,161.53	4
38.83	127.35	207.93	893.66	68.16	961.82	5
36.70	127.35	207.93	957.26	7.55	964.81	6
43.64	127.35	207.93	951.04	25.17	976.21	7
51.49	127.35	207.93	1,081.57	- 34.96	1,046.61	8
71.27	127.35	207.93	1,183.96	- 11.72	1,172.24	9
75.34	127.35	207.93	1,084.10	- 34.32	1,049.78	10
37.98	127.35	207.93	995.27	28.72	1,023.99	11
74.89	127.35	207.93	1,086.95	42.35	1,129.30	12
120.58	127.35	207.93	1,183.58	- 9.87	1,173.71	13
52.14	127.35	207.93	1,038.59	- 16.88	1,021.71	14
70.48	127.35	207.93	1,073.27	30.99	1,104.26	15
21.44	127.35	207.93	956.09	- 18.46	937.63	16
36.70	127.35	207.93	945.63	- 25.49	920.14	17
24.75	127.35	207.93	931.46	- 12.61	918.85	18
40.46	26.37	207.93	1,080.14	- 2.17	1,077.97	19
48.63	26.37	207.93	1,347.24	- 44.18	1,303.06	20
24.61	26.37	207.93	966.20	7.58	973.78	21

expenditures. In order to fit capital costs into the same framework as operating expenses, this one-time stock expenditure must be converted into an equivalent flow of expenditures. For this computation one needs to know what hypothetical annual imputed rent school planners would be willing to pay in each year of use instead of incurring the one-time costs directly.

An example of how a school finances this one-time cost may clarify the imputed-rent concept. The one-time fixed cost of a building is usually financed by a bond issue. The school division then faces the cash-flow problem of meeting interest and principal payments over the life of the bonds. Using the annual interest and principal payments to represent the imputed rent for any one year may misrepresent the true annual cost to the division. Consider the situation 20 years after the construction of a school building financed with 20-year bonds. (A common bond repayment period is 20 years.1/) Since on the average a school building is used for 25 to 40 years, the facility would probably still be in use.2/ Is it reasonable to assign an imputed rent equal to the interest and bond repayments in year 20, and then one year later, in the twenty-first year of use, to assign an imputed rent of zero? Clearly, the school administration would be willing to pay something for the use of the building in year 21 and subsequently until the structure could no longer be used. Over the 20 years of the bond repayment period, the division has made annual payments greater than the imputed rent and is compensated by making zero payments in the later years.

Ideally, the cost of construction should be spread over the life of the building. However, the useful life of a structure is uncertain in terms of both its physical durability and its embodied technological characteristics. Even if a structure remains physically sound for 50 years, there is no assurance that it will continue to meet educational needs. It is also likely that within the useful life of the facility significant remodeling would be needed. These costs have to be integrated into the derivation of imputed rent figures and this additional uncertainty makes it difficult to calculate imputed rents over long periods.

This study employs two imputed rents for each year.3/ The first assumes a 20-year period for complete principal

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1/ This practice is set by the time limits of the Literary Loan Fund, a state revolving fund.

2/ Roberts and Lichtenburger, Financial Accounting, p. 67.

3/ The formula used is $R = C \frac{i(1 + i)^n}{(1 + i)^{n-1}}$ where R is the imputed rent, C is the cost of construction, i is the rate of discount, and n the number of years. The formula provides for the calculation of straight-line amortization of the construction cost over the life of the school and the addition of interest on the average balance outstanding.

retirement. This may be viewed as a maximum rent figure, since the facility will probably be in use for some time after year 20. The second imputed rent figure is based on a bond repayment period of 30 years; future uncertainties make this a justifiable procedure. Both imputed rent figures are used in all cost calculations and comparisons. A discount rate of 6 percent is used in the study. Over the two years of the 45-15 project the interest rate on Aa municipal bonds averaged slightly less than 6 percent.1/

In 1973-74 two elementary buildings were constructed by Loudoun County (Rolling Ridge and Sugarland). Each school was approximately 54,000 square feet and had a capacity of 700 students. The contract bids averaged $1,963,000 or $36.35 per square foot. The annual cost of this type facility would be $171,174 discounted over a 20-year period and $142,514 over a 30-year period. The annual imputed rents per square foot were $3.1699 and $2.6391, respectively. These figures were for 1973-74. Since imputed rent in this study is based on replacement cost, it is necessary to develop separate estimates for 1974-75. This is accomplished by using the U.S. Department of Commerce composite construction index to adjust the earlier year data.2/ The results for both years are presented in table 3.3.

In the 1974-75 school year, contract bids were received for the construction of two middle schools (Seneca Ridge and J. Lupton Simpson) in Loudoun County. The average bid for the construction of these 132,422-square-foot facilities for 1,200 students was approximately $4,530,000. Middle school per-square-foot construction costs were derived for both 1973-74 and 1974-75 using the same procedure as outlined for the elementary schools. These figures and a summary of the per-square-foot figures for the elementary and the middle schools are shown in Table 3.3.

These figures are used to derive imputed rents in the mock-school analysis found in chapter 4. The total number of square feet in the school being examined is multiplied by the square foot imputed rent to derive the annual imputed rent for the facility.

This procedure cannot be used in the cross-sectional analysis because of the dissimilarity between schools in the

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1/ U.S. Department of the Treasury, Treasury Bulletin, January 1976, p. 85.

2/ U.S. Department of Commerce, Construction Review, 27, no. 7 (August 1975): 41.

TABLE 3.3

ANNUAL IMPUTED RENT PER SQUARE FOOT OF SELECTED LOUDOUN COUNTY SCHOOLS, 1973-74 AND 1974-75

	Bond Period Assumption	
	20 Years	30 Years
Rolling Ridge and Sugarland Elementary Schools		
1973-74	$3.1699	$2.6391
1974-75	3.6077	3.0036
Seneca Ridge and Simpson Elementary Schools		
1973-74	2.6209	2.1821
1974-75	2.9830	2.4836

amount of floor space per student--a variation which is illustrated for selected schools in table 3.4.1/ If the square-foot-imputed-rent procedure were used on these diverse figures, differences in cost between traditional and 45-15 schools would include differences due to variance in square foot ratios as well as those due to the alternative school calendars. Therefore, an alternative procedure is used in the cross-sectional study.

The annual imputed rents are converted to imputed rent per unit of capacity figures by dividing the total imputed rent of the new elementary facilities by 700 (the rated capacity of the new facilities) and the new middle school figures by 1,200. These figures are reported in table 3.5. The following example illustrates the procedure for deriving these estimates. For Rolling Ridge and Sugarland elementary schools the imputed rent for each facility was determined to be

1/ In some cases space per student differs between years for the same facility because of building additions and the use of classroom trailers.

TABLE 3.4

SQUARE FEET PER STUDENT BASED ON TRADITIONAL CAPACITY FOR SELECTED LOUDOUN COUNTY SCHOOLS, 1973-74 AND 1974-75

School	Square Feet per Student 1973-74	1974-75
Elementary schools		
Catoctin	86.40	72.74
Douglass	72.16	72.16
Lovettsville	64.96	85.61
Guilford	89.61	89.23
Sterling	84.35	86.72
Sully	90.91	93.87
Middle schools		
Blue Ridge	110.48	110.48
Leesburg	84.62	84.62
Sterling	110.48	110.48

TABLE 3.5

IMPUTED RENT PER STUDENT BASED ON TRADITIONAL CAPACITY IN LOUDOUN COUNTY SCHOOLS, 1973-74 AND 1974-75

	Bond Period Assumption 20 Years	30 Years
Elementary school		
1973-74	$244.53	$203.59
1974-75	278.28	231.69
Middle school		
1973-74	289.25	240.83
1974-75	329.18	274.07

$171,174 over a 20-year period and $142,514 over a 30-year period. The traditional rated capacity of these facilities was 700 students. Therefore, the imputed rent per student based on traditional capacity was $\frac{\$171,174}{700} = \$244.53$ for a 20-year-bond assumption and $\frac{\$142,514}{700} = \$203.59$ for a 30-year-bond assumption. These figures representing annual per pupil costs of the two new elementary schools are also used to represent traditional per student capital cost in the cross-sectional analysis. An obvious objection is that the figures developed in this manner are only relevant to elementary schools with a capacity of 700 and middle schools with a capacity of 1,200 students. Extrapolation of these per student costs to facilities of a different size requires the assumption of a proportional relationship between construction costs and school capacity. Two points may be made in defense of this procedure. First, the proportionality assumption is not unreasonable within the range of school sizes being analyzed. Second, the research objectives are such that the procedure represents a logical framework for comparison of year-round and traditional school costs.

This second point requires discussion. Given that the representation of the cost-size relationship is not perfect, the estimate of per student imputed rent would be biased downward for schools smaller than 700 (1,200) and biased upward for schools larger than 700 (1,200) in capacity. Most of the elementary schools being compared have a traditional capacity of less than 700. Estimates of per student imputed rent for these schools would be biased downward, and 45-15 capital savings would be understated. However, if the trend is toward building larger schools, the derived savings are not understatements. Rather, the analysis has adapted the cost savings to the trend in facility size. The alternative to 45-15 is capital expenditures on new schools, probably with a capacity of 700 (1,200), since the newest buildings were of this size; the imputed rent figures reflect this possibility. In addition, by using these figures for a student facility of 700 (1,200), the entire cross-sectional analysis has been adjusted for differences in imputed rent due to facility size. Since the research objective is to determine cost differentials due to type of school calendar, this standardization tends to improve the analysis.

The figures in table 3.5 represent per student imputed rent under the traditional plan. The derivation of per student imputed rent for the 45-15 schools involves a different procedure. The ratio of the ADM of each 45-15 school to that school's rated capacity under the traditional plan is calculated. The imputed rent for the traditional plan is then divided by this ratio for each 45-15 school. Theoretically, this ratio could be as high as 1.33 since the 45-15 program is designed to

accommodate one-third more students than a traditional program in the same school building. However, the actual ratio of 45-15 ADM to rated capacity was usually less than 1.33 in the Loudoun County schools.

The following example illustrates the derivation of imputed rent for 45-15 schools. In 1973-74 Sterling M.S. had a rated capacity of 1,050 pupils under the traditional plan. Operating year-round it accommodated an ADM of 1,389.36. This meant that $\frac{1,389.36}{1,050} = 1.32$ of the traditional capacity was handled in 1973-74. Therefore, the annual imputed rent for the facility was covering 32 percent more students. The per student imputed rent under 45-15 is equal to the traditional per student imputed rent divided by 1.32. For Sterling M.S. the figure was $\frac{\$289.25}{1.32} = \$219.13$. Per student imputed rents for all 45-15 schools in each year are reported in table 3.6.

TABLE 3.6

IMPUTED RENT PER STUDENT FOR 45-15 SCHOOLS

IN LOUDOUN COUNTY, 1973-74 AND 1974-75

School Year	Ratio of $\frac{45\text{-}15\ ADM}{Capacity}$	Per Student Imputed Rent Given under Bond Period Assumption	
		20 Years	30 Years
Guilford E.S.			
1973-74	1.16	$ 210.80	$ 175.51
1974-75	1.07	260.08	216.53
Sterling E.S.			
1973-74	1.22	200.43	166.88
1974-75	1.20	231.90	193.08
Sully E.S.			
1973-74	1.50	163.02	135.73
1974-75	1.31	212.43	176.86
Sterling M.S.			
1973-74	1.32	219.13	182.45
1974-75	1.36	242.04	201.52

Miscellaneous capital costs are those incurred due to growth in the system and/or those that, due to the information available, could not be handled in the same manner as building capital.[1] Items included in miscellaneous capital cost are additions to the bus fleet due to growth, additions to the motor vehicle fleet due to expanded programs, building alterations and property improvements to upgrade facilities and increase services, and additional furniture and equipment to meet the needs of an increased enrollment and expanded programs.

Because of minor fluctuations in cost resulting from growth during 1972-73 and 1973-74 and from the planning and introduction of a new program in 1973-74 and 1974-75, these miscellaneous capital costs were averaged over a five-year period (1970-71 to 1974-75). The following procedure was used: (1) the total miscellaneous capital cost for each year was adjusted to constant 1967 dollars using the durable goods component of the consumer price index; (2) the 1967 dollar expenditures for the five-year period were summed, and the average annual outlay was calculated; (3) the average expenditures for 1973-74 and 1974-75 were determined by readjusting the average outlay figures to 1973 and 1974 dollars respectively, and (4) average per student miscellaneous capital costs were then calculated for each school year by using the ADM for that year.

Cross-Sectional Comparison

Ideally, comparisons of cost per ADM in each school should involve facilities of the same size to eliminate distortions associated with economies of scale. However, for Loudoun County schools the 45-15 schools generally had a higher rated traditional capacity than the traditional schools. This is illustrated in table 3.7 which shows rated traditional capacity figures for the three *largest* traditional elementary schools, the three 45-15 elementary schools, the two traditional middle schools, and the one 45-15 middle school. Although not ideal, this is the group for which total cost per ADM is shown in tables 3.8 and 3.9. From these tables a large number of comparisons may be made.

In table 3.10 certain comparisons are selected for further analysis because of their particular significance. For the elementary schools three comparisons are made. First, the average per student total adjusted costs in the traditional elementary schools shown in tables 3.8 and 3.9 are compared with the average per student costs in the 45-15 schools.

1/ These items are included in the maintenance category when they are not growth related.

TABLE 3.7

RATED TRADITIONAL CAPACITY OF SELECTED TRADITIONAL SCHOOLS AND 45-15 SCHOOLS IN LOUDOUN COUNTY, 1973-74 AND 1974-75

Type of School	Rated Traditional Capacity in Terms of ADM 1973-74	1974-75[a/]
3 largest traditional elementary		
Catoctin	500	850
Lovettsville	300	500
Douglass	300	300
45-15 elementary		
Guilford	500	600
Sterling	685	745
Sully	560	620
Traditional middle		
Blue Ridge	1,050	1,050
Leesburg	560	560
45-15 middle		
Sterling	1,050	1,130

a/ In several cases capacity was higher in 1974-75 due to the use of classroom trailers or building expansion.

TABLE 3.8

TOTAL COST PER ADM OF SELECTED TRADITIONAL SCHOOLS AND 45-15 SCHOOLS IN LOUDOUN COUNTY, 1973-74

Type of School and (ADM)	Total Operating Cost	Imputed Rent	Miscellaneous Capital Costs	Total	Class-Size Adjustment Factor	Adjusted Total
Traditional elementary						
Catoctin (536.35)						
High rent a/	$841.06	$244.53	$21.16	$1,106.75	$56.75	$1,163.50
Low rent b/	841.06	203.59	21.16	1,065.81	56.75	1,122.56
Douglass (264.89)						
High rent	963.52	244.53	21.16	1,229.21	- 61.93	1,167.28
Low rent	963.52	203.59	21.16	1,188.27	- 61.93	1,126.34
Lovettsville (254.34)						
High rent	861.91	244.53	21.16	1,127.60	30.57	1,158.17
Low rent	861.91	203.59	21.16	1,086.66	30.57	1,117.23
Traditional elementary 3-school average						
High rent	888.83	244.53	21.16	1,154.52	8.46	1,162.98
Low rent	888.83	203.59	21.16	1,113.58	8.46	1,122.04
45-15 elementary						
Guilford (578.69)						
High rent	884.54	210.80	21.16	1,116.50	- 6.39	1,110.11
Low rent	884.54	175.51	21.16	1,081.21	- 6.39	1,074.82
Sterling (835.87)						
High rent	855.68	200.43	21.16	1,077.27	- 12.37	1,064.90
Low rent	855.68	166.88	21.16	1,043.72	- 12.37	1,031.35
Sully (840.33)						
High rent	804.83	163.02	21.16	989.01	27.65	1,016.66
Low rent	804.83	135.67	21.16	961.66	27.65	989.31
45-15 elementary 3 school-average						
High rent	848.35	191.41	21.16	1,060.92	2.96	1,063.88
Low rent	848.35	159.35	21.16	1,028.86	2.96	1,031.82
Traditional middle						
Blue Ridge (958.24)						
High rent	937.92	289.25	21.16	1,248.33	17.31	1,265.64
Low rent	937.92	243.83	21.16	1,202.91	17.31	1,220.22
Leesburg (513.60)						
High rent	1,045.85	289.25	21.16	1,356.26	- 21.65	1,334.61
Low rent	1,045.85	243.83	21.16	1,310.84	- 21.65	1,289.19
Traditional middle 2-school average						
High rent	991.89	289.25	21.16	1,302.30	- 2.17	1,300.13
Low rent	991.89	243.83	21.16	1,256.88	- 2.17	1,254.71
45-15 middle						
Sterling (1,389.36)						
High rent	898.95	219.13	21.16	1,139.24	- 2.86	1,136.38
Low rent	898.95	182.45	21.16	1,102.56	- 2.86	1,099.70

Notes: Details may not add to totals due to rounding.
All averages are simple averages.

a/ High: Assumes a 20-year bond.

b/ Low : Assumes a 30-year bond.

TABLE 3.9

TOTAL COST PER ADM OF SELECTED TRADITIONAL SCHOOLS AND 45-15 SCHOOLS IN LOUDOUN COUNTY, 1974-75

Type of School and (ADM)	Total Operating Cost	Imputed Rent	Miscellaneous Capital Costs	Total	Class-Size Adjustment Factor	Adjusted Total
Traditional elementary						
Catoctin (579.99)						
High rent a/	$893.66	$278.28	21.57	$1,193.52	$68.16	$1,261.68
Low rent b/	893.66	231.69	21.57	1,146.92	68.16	1,215.08
Douglass (287.00)						
High rent	957.26	278.28	21.57	1,257.12	7.55	1,264.67
Low rent	957.26	231.69	21.57	1,210.52	7.55	1,218.07
Lovettsville (251.56)						
High rent	995.27	278.28	21.57	1,295.13	28.72	1,323.85
Low rent	995.27	231.69	21.57	1,248.53	28.72	1,277.25
Traditional elementary 3-school average						
High rent	948.73	278.28	21.57	1,248.59	34.81	1,283.40
Low rent	948.73	231.69	21.57	1,201.99	34.81	1,236.80
45-15 elementary						
Guilford (642.98)						
High rent	956.09	260.08	21.57	1,237.74	- 18.46	1,219.28
Low rent	956.09	216.53	21.57	1,194.19	- 18.46	1,175.73
Sterling (890.97)						
High rent	945.63	231.90	21.57	1,199.10	- 25.49	1,173.61
Low rent	945.63	193.08	21.57	1,160.28	- 25.49	1,134.79
Sully (810.12)						
High rent	931.46	212.43	21.57	1,165.46	- 12.61	1,152.85
Low rent	931.46	176.86	21.57	1,129.89	- 12.61	1,117.28
45-15 elementary 3-school average						
High rent	944.39	134.80	21.57	1,200.76	- 18.85	1,181.91
Low rent	944.39	195.49	21.57	1,161.45	- 18.85	1,142.60
Traditional middle						
Blue Ridge (946.75)						
High rent	1,080.14	329.18	21.57	1,430.89	- 2.17	1,428.72
Low rent	1,080.14	274.07	21.57	1,375.78	- 2.17	1,373.61
Leesburg (520.89)						
High rent	1,347.24	329.18	21.57	1,697.99	- 44.18	1,653.81
Low rent	1,347.24	274.07	21.57	1,642.88	- 44.18	1,598.70
Traditional middle 2-school average						
High rent	1,213.69	329.18	21.57	1,564.44	- 23.18	1,541.26
Low rent	1,213.69	274.07	21.57	1,509.33	- 23.18	1,486.15
45-15 middle						
Sterling (1,534.40)						
High rent	966.20	242.04	21.57	1,229.81	7.58	1,237.39
Low rent	966.20	201.52	21.57	1,189.29	7.58	1,196.87

Notes: Details may not add to totals due to rounding.
All averages are simple averages.

a/ High: Assumes a 20-year bond.

b/ Low : Assumes a 30-year bond.

TABLE 3.10

SELECTED CROSS-SECTIONAL COMPARISONS OF PERCENTAGE SAVINGS IN TOTAL ADJUSTED COSTS PER ADM, LOUDOUN COUNTY SCHOOLS, 1973-74 AND 1974-75

	Comparison of:		45-15 % Savings under Bond Period Assumption of:	
	Traditional	45-15	20 Years	30 Years
Elementary schools				
1973-74	Traditional elementary 3-school average	45-15 elementary 3-school average	8.5%	8.0%
	Lovettsville	Guilford	4.2	3.8
	Douglass	Sterling	8.8	8.4
1974-75	Traditional elementary 3-school average	45-15 elementary 3-school average	7.9	7.6
	Catoctin	Guilford	3.4	3.2
	Lovettsville	Sully	12.9	12.5
Middle schools				
1973-74	Traditional middle 2-school average	Sterling	12.6	12.4
	Blue Ridge	Sterling	10.2	9.9
1974-75	Traditional middle 2-school average	Sterling	19.7	19.5
	Blue Ridge	Sterling	13.4	12.9

Source: tables 3.8 and 3.9.

Under the 20-year-bond assumption the 1973-74 savings for 45-15 were 8.5 percent, and under the 30-year-bond assumption they were 8.0 percent. Similar results were achieved in 1974-75; the savings for 45-15 were 7.9 percent under the 20-year-bond assumption and 7.6 percent under the 30-year-bond assumption. A second comparison involves the lowest per student cost in the traditional schools and the highest per student cost in the 45-15 schools. This comparison provides the most favorable treatment of the traditional plan. Using a 20-year-bond assumption, Guilford, the highest-cost 45-15 school, had 1973-74 costs 4.2 percent lower than Lovettsville, the lowest-cost traditional school. Similar savings occurred under the 30-year-bond assumption in 1973-74. In 1974-75 Guilford was again the highest-cost 45-15 school, but Catoctin was the lowest-cost traditional school. However, Guilford's cost savings relative to Catoctin were slightly lower than those relative to Lovettsville in the previous year. The third comparison is made between the highest-cost traditional elementary school and the lowest-cost 45-15 school, a comparison technique least favorable to the traditional plan.1/ Based on a 20-year-bond assumption, costs at Sterling, the lowest-cost 45-15 school, were 8.8 percent lower than those at Douglass, the highest-cost traditional school in 1973-74. Similar savings occurred under the 30-year-bond assumption. In 1974-75 costs at Sully, the lowest-cost 45-15 school, were 12.9 percent below those at Lovettsville, the highest-cost traditional school. This comparison is based on a 20-year-bond assumption. Using a 30-year-bond assumption makes little difference in the percentage saving.

For the middle schools in 1973-74, the average per student adjusted total costs for the traditional schools were compared with the per student costs of Sterling M.S. The savings were 12.6 percent if a 20-year period is used to discount capital and 12.4 percent if a 30-year period is used. (See table 3.10.) For 1974-75 these figures were 19.7 percent and 19.5 percent, respectively. Leesburg M.S. represents an atypical facility; it is an old structure compared with the other middle schools, and the ADM is significantly lower than that of the other schools. A more valid comparison may be made between Blue Ridge M.S. and Sterling M.S.2/ Sterling M.S. in 1973-74 had

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1/ Sully is not used for this comparison in 1973-74 because the facility was overcrowded. The rated capacity of the facility was 560, while the ADM was 840.33. Enrollment under 45-15 increased by more than 33 percent of the traditional capacity, and thus the estimate of the per student imputed rent was very low. The following year the capacity increased while enrollment declined.

2/ In addition, Blue Ridge M.S. and Sterling M.S. were twin schools and were constructed at the same time. This adds validity to the comparison.

10.2 percent lower per student costs evaluated under the 20-year-bond assumption and 9.9 percent under the 30-year-bond assumption. In 1974-75 the figures were 13.4 percent and 12.9 percent, respectively.

In summary, the cross-sectional data reveal consistent cost savings under 45-15 with the relative magnitude varying among schools and between years. In general, the savings are greater at the middle school than at the elementary school level. Although these findings are important, they do not provide conclusive evidence of 45-15 savings because of the previously mentioned limitations of the cross-sectional method. To augment the study, a different type of cost analysis is presented in chapter 4.

CHAPTER 4

MOCK-SCHOOL ANALYSIS

In chapter 3 cross-sectional comparisons were made between 45-15 and traditional schools to discern the effects on costs of operating under these alternative school schedules. The principal difficulty with this approach is that cost differences between any two schools cannot be attributed solely to differences in the type of school calendar. The size of the facility, the type of heating system, the age of the structure, and other factors may cause significant cost differences that cannot be controlled for in a study of this type. Given these problems, an alternative formulation of the comparison would be helpful for a more complete understanding of the issues. In this chapter such an alternative is presented, and the derived figures are compared with the findings in chapter 3.

In the Turnkey Associates study of the Prince William County plan (see chapter 2) actual per student costs were determined for a 45-15 school and mock costs were determined for the same facility operating under the traditional plan. This section reports on a similar procedure developed for the Loudoun County 45-15 schools.

In the Turnkey approach ADM differs in the 45-15 and the traditional modes of operation. In this study ADM is assumed to be equal under both modes. This difference in methodology results in a comparison most favorable to the traditional plan in that 45-15 savings are likely to be smaller in this framework than in the Turnkey framework.1/ Costs for the mock traditional

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1/ As a school's ADM increases, certain economies of scale can result in decreasing costs per ADM. If this is true, the larger traditional school having an ADM equal to 45-15 ADM will have smaller per pupil costs than the Turnkey mock school having an ADM equal to three-fourths of 45-15 ADM. By using the larger school in the Loudoun comparison, a minimum cost savings figure is derived, since the analysis allows a larger traditional facility to be viewed as a substitute for 45-15 scheduling. Clearly this is not a short-run option, but it is possible to change facility size over a longer planning period.

school are determined in two components: first, the costs of educating the number of students equal to the school's rated traditional capacity; and, second, the costs of educating the additional student population serviced by the 45-15 system. This procedure assumes that an addition to the facility is constructed to provide the extra square footage needed to accommodate the extra students. This two-step procedure is done for each of the 45-15 schools for each year of 45-15 operation.

Guilford E.S. provides an example of this procedure. (See table 4.1.) In 1973-74 Guilford had an ADM of 578.69 and a rated traditional capacity of 500. Column one lists and sums the cost of educating 578.69 students under a traditional calendar, while in column three these costs are expressed on a per ADM basis. Columns two and four itemize and sum the costs of educating the same number of students under the 45-15 plan on a total and on a per ADM basis, respectively. The imputed rent in table 4.1 is derived using the annual imputed rent per square foot of space as calculated in table 3.3. Under the 20-year-bond assumption this rent is $3.1699, while it is $2.6391 per square foot over a 30-year discount period. Guilford School had a total square footage of 44,800 in 1973-74, and therefore the imputed rent over 20 years would be $3.1699 times 44,800, or $142,024. A similar calculation would yield $118,242 over a 30-year period. In order to accommodate a traditional ADM of 578.69 at Guilford, 7,051.41 additional square feet of capacity would be required to serve the additional 78.69 students served by 45-15. The annual cost of this extra space would be 7,051.41 times $3.1699 or $22,355 under the 20-year-bond assumption. Under the 30-year-bond assumption this cost would be 7,051.41 times $2.6391, or $18,612. These additional costs account for the higher total imputed rent shown in column one of table 4.1. In tables 4.2 through 4.4, mock-school costs are derived, reported, and compared with 45-15 costs for Sterling E.S., Sully E.S., and Sterling M.S.

Other aspects of these comparisons include:

1. One principal and one nurse were required regardless of ADM within the ADM range considered. For each day of student attendance, a nurse and a principal must be present. Since the principal was already on an extended contract in the traditional middle school, no cost differentials existed in this category. However, the increased number of student attendance days meant that additional nurse-contact days had to be purchased under the 45-15 plan. For Sterling M.S. a part-time nurse was hired.

2. In the mock school the need for deans, counselors, and assistant principals was determined based on

TABLE 4.1

COSTS OF GUILFORD ELEMENTARY SCHOOL ON A MOCK TRADITIONAL AND 45-15 BASIS, 1973-74 AND 1974-75

(Based on an ADM of 578.69 in 1973-74 and 642.98 in 1974-75)

	1973-74						1974-75					
	Total Costs		Costs Per ADM				Total Costs		Costs Per ADM			
	Mock Traditional $	45-15 $	Mock Traditional $	45-15 $	Difference $	Difference %	Mock Traditional $	45-15 $	Mock Traditional $	45-15 $	Difference $	Difference %
Administration at school	38,132	40,245	65.89	69.54	3.65	5.5	42,581	45,045	66.22	70.06	3.84	5.8
Principal	15,889	17,667	27.46	30.53	3.07	11.2	17,733	19,695	27.58	30.63	3.05	11.1
Assistant principal	11,627	11,941	20.09	20.64	0.55	2.7	12,814	13,155	19.93	20.46	0.53	2.7
Secretaries	10,616	10,636	18.35	18.38	0.03	0.2	12,035	12,195	18.72	18.97	0.25	1.3
Instructional salaries	252,390	254,101	436.14	439.10	2.96	0.7	306,844	300,630	477.22	467.56	- 9.66	- 2.0
Teachers and aides	240,028	240,028	414.78	414.78	...	...	294,129	286,195	457.45	445.11	-12.43	- 2.7
Librarian	9,851	11,562	17.02	19.98	2.96	17.4	10,079	11,799	15.68	18.35	2.67	17.0
Library clerk	2,511	2,511	4.34	4.34	...	...	2,636	2,636	4.10	4.10	...	...
Instructional costs other than salaries	6,723	6,723	11.62	11.62	...	...	8,797	8,797	13.68	13.68	...	...
Utilities and fuel	16,460	15,578	28.44	26.92	- 1.52	- 5.3	31,155	30,912	48.45	48.08	- 0.37	- 0.8
Fuel	6,767	5,847	11.69	10.10	- 1.59	-13.6	10,437	9,740	16.23	15.15	- 1.08	- 6.7
Electricity	7,617	7,656	13.16	13.23	0.07	0.5	18,191	18,646	28.29	29.00	0.71	2.5
Other	2,075	2,075	3.59	3.59	...	...	2,526	2,526	3.93	3.93	...	...
Maintenance	15,814	15,331	27.33	26.49	- 0.84	- 3.1	14,217	13,785	22.11	21.44	- 0.67	- 3.0
Head custodian	6,491	6,491	11.22	11.22	...	...	6,907	6,907	10.74	10.74	...	...
Assistant custodians	7,450	7,226	12.87	12.49	- 0.38	- 3.0	3,677	3,401	5.72	5.29	- 0.43	- 7.5
Custodial supplies	1,873	1,615	3.24	2.79	- 0.45	-13.9	2,337	2,180	3.63	3.39	- 0.24	- 6.6
Other[a]	...	...	...	...	...	...	1,297	1,297	2.02	2.02	...	...
Elementary school overhead	60,161	60,161	103.96	103.96	...	...	81,884	81,884	127.35	127.35	...	...
Division-wide overhead	122,700	122,700	212.03	212.03	...	...	133,695	133,695	207.93	207.93	...	...
Total operating costs	512,379	514,839	885.42	889.67	4.25	0.5	619,174	614,748	962.98	956.09	- 6.89	- 0.7
Miscellaneous capital costs	12,245	12,245	21.16	21.16	...	...	13,869	13,869	21.57	21.57	...	...
Imputed rent[b]												
20-year	164,379	142,024	284.05	245.42	-38.63	-13.6	206,974	193,145	321.90	300.39	-21.51	- 6.7
30-year	136,854	118,242	236.49	204.33	-32.16	-13.6	172,318	160,804	268.00	250.09	-17.91	- 6.7
Total costs under bond period assumption of:												
20 years	689,004	669,108	1,190.63	1,156.25	-34.38	- 2.9	840,016	821,762	1,306.44	1,278.05	-28.39	- 2.2
30 years	661,478	645,325	1,143.06	1,115.15	-27.91	- 2.4	805,360	789,421	1,252.54	1,227.75	-24.79	- 2.0

Note: Details may not add to totals due to rounding.

a/ Included by Loudoun County schools in division-wide overhead in 1973-74 (see page 55).

b/ Note that this rent is derived using costs per square foot figures and the actual square feet per student ratio for this school. The procedure differs from that used in the cross-sectional analysis. See p. 25 for a detailed explanation.

TABLE 4.2

COSTS OF STERLING ELEMENTARY SCHOOL ON A MOCK TRADITIONAL AND 45-15 BASIS, 1973-74 AND 1974-75

(Based on an ADM of 835.87 in 1973-74 and 890.77 in 1974-75)

	1973-74						1974-75					
	Total Costs		Costs Per ADM				Total Costs		Costs Per ADM			
	Mock Traditional	45-15	Mock Traditional	45-15	Difference		Mock Traditional	45-15	Mock Traditional	45-15	Difference	
	$	$	$	$	$	%	$	$	$	$	$	%
Administration at school	38,111	40,219	45.59	48.12	2.53	5.5	42,581	45,015	47.80	50.54	2.74	5.7
Principal	15,809	17,667	19.01	21.14	2.13	11.2	17,733	19,695	19.90	22.11	2.21	11.1
Assistant principal	11,627	11,941	13.91	14.29	0.38	2.7	12,814	13,155	14.38	14.76	0.38	2.6
Secretaries	10,594	10,611	12.67	12.69	0.02	0.2	12,035	12,165	13.51	13.65	0.14	1.0
Instructional salaries	361,277	362,758	432.22	433.99	1.77	0.4	420,526	419,976	472.09	471.48	- 0.62	- 0.1
Teachers and aides	348,915	348,685	417.43	417.15	- 0.28	- 0.1	407,810	405,540	457.71	455.17	- 2.54	- 0.6
Librarian	9,851	11,562	11.78	13.83	2.05	17.4	10,079	11,758	11.31	13.24	1.93	17.1
Library clerk	2,511	2,511	3.00	3.00	...	...	2,636	2,636	2.96	2.96	...	...
Instructional costs other than salaries	8,675	8,675	10.38	10.38	...	...	11,364	11,364	12.75	12.75	...	...
Utilities and fuel	32,217	28,347	38.54	33.91	- 4.63	-12.0	40,575	36,467	45.55	40.94	- 4.61	-10.1
Fuel	7,878	6,456	9.43	7.72	- 1.71	-18.1	13,802	11,541	15.49	12.95	- 2.54	-16.4
Electricity	21,251	18,803	25.42	22.50	- 2.92	-11.5	23,583	21,736	26.47	24.40	- 2.07	- 7.8
Other	3,087	3,087	3.69	3.69	...	...	3,190	3,190	3.58	3.58	...	...
Maintenance	15,117	12,587	18.09	15.06	- 3.03	-16.0	35,163	32,696	39.48	36.71	- 2.77	- 7.0
Head custodian	1,039	1,039	1.24	1.24	...	...	6,907	6,907	7.76	7.76	...	...
Assistant custodians	11,539	9,467	13.81	11.33	- 2.48	-18.0	13,755	11,807	15.44	13.25	- 2.19	-14.2
Custodial supplies	2,539	2,081	3.04	2.49	- 0.55	-18.1	3,165	2,646	3.55	2.97	- 0.58	-16.3
Other[a]	...	...	...	...	...	...	11,336	11,336	12.72	12.72	...	...
Elementary school overhead	86,897	86,897	103.96	103.96	...	...	113,465	113,465	127.35	127.35	...	...
Division-wide overhead	177,230	177,230	212.03	212.03	...	...	185,259	185,259	207.93	207.93	...	...
Total operating costs	719,523	716,712	860.81	857.44	- 3.37	- 0.4	848,933	844,241	952.82	947.55	- 5.27	- 0.6
Miscellaneous capital costs	17,687	17,687	21.16	21.16	...	...	19,218	19,218	21.57	21.57	...	...
Imputed rent[b]												
20-year	223,492	183,160	267.38	219.13	-48.25	-18.1	278,697	233,083	312.87	261.66	-51.21	-16.4
30-year	186,068	152,490	222.60	182.43	-40.17	-18.1	232,030	194,054	260.48	217.85	-42.63	-16.4
Total costs under bond period assumption of:												
20 years	960,702	917,559	1,149.34	1,097.73	-51.61	- 4.5	1,146,848	1,096,543	1,287.25	1,230.78	-56.47	- 4.4
30 years	923,278	886,889	1,104.57	1,061.04	-43.53	- 3.9	1,100,181	1,057,513	1,234.86	1,186.97	-47.89	- 3.9

Note: Details may not add to totals due to rounding.

a/ Included by Loudoun County schools in division-wide overhead in 1973-74 (see page 55).

b/ Note that this rent is derived using costs per square foot figures and the actual square feet per student ratio for this school. The procedure differs from that used in the cross-sectional analysis. See p. 25 for a detailed explanation.

TABLE 4.3

COSTS OF SULLY ELEMENTARY SCHOOL ON A MOCK TRADITIONAL AND 45-15 BASIS, 1973-74 AND 1974-75

(Based on an ADM of 840.33 in 1973-74 and 810.12 in 1974-75)

	1973-74						1974-75					
	Total Costs		Costs Per ADM				Total Costs		Costs Per ADM			
	Mock Traditional	45-15	Mock Traditional	45-15	Difference		Mock Traditional	45-15	Mock Traditional	45-15	Difference	
	$	$	$	%	$	%	$	$	$	$	$	%
Administration at school	38,063	40,148	45.30	47.78	2.48	5.5	42,581	44,907	52.56	55.43	2.87	5.5
Principal	15,889	17,667	18.91	21.02	2.11	11.2	17,733	19,695	21.89	24.31	2.42	11.1
Assistant principal	11,627	11,941	13.84	14.21	0.37	2.7	12,814	13,155	15.82	16.24	0.42	2.7
Secretaries	10,547	10,539	12.55	12.54	0.01	...a/	12,035	12,057	14.86	14.88	0.02	0.1
Instructional salaries	339,678	340,790	404.22	405.54	1.32	0.3	373,810	372,851	461.43	460.24	- 1.19	- 0.3
Teachers and aides	327,317	326,718	389.51	388.80	- 0.71	- 0.2	361,095	358,416	445.73	442.42	- 3.31	- 0.7
Librarian	9,850	11,562	11.72	13.76	2.04	17.4	10,079	11,799	12.44	14.56	2.21	17.0
Library clerk	2,511	2,511	2.99	2.99	...	...	2,636	2,636	3.25	3.25	...	...
Instructional costs other than salaries	8,715	8,715	10.37	10.37	...	...	10,739	10,739	13.26	13.26	...	...
Utilities and fuel	23,246	17,446	27.66	20.76	- 6.90	-24.9	43,789	35,978	54.05	44.41	- 9.64	-17.8
Fuel	10,719	7,143	12.76	8.50	- 4.26	-33.4	17,338	13,269	21.40	16.38	- 5.02	-23.5
Electricity	10,330	8,105	12.29	9.65	- 2.64	-21.5	23,688	19,945	29.24	24.62	- 4.62	-15.8
Other	2,197	2,197	2.61	2.61	...	...	2,764	2,764	3.41	3.41	...	...
Maintenance	18,394	15,239	21.89	18.14	- 3.75	-17.2	22,721	20,047	28.05	24.74	- 3.31	-11.8
Head custodian	6,491	6,491	7.72	7.72	...	...	6,907	6,907	8.53	8.53	...	...
Assistant custodians	9,155	6,916	10.89	8.23	- 2.66	-24.4	10,699	8,758	13.21	10.81	- 2.40	-18.2
Custodial supplies	2,748	1,832	3.27	2.18	- 1.09	-33.3	3,099	2,366	3.83	2.92	- 0.91	-23.8
Other[b]	...	...	...	...	...	...	2,016	2,016	2.49	2.49	...	...
Elementary school overhead	87,361	87,361	103.96	103.96	...	...	103,169	103,169	127.35	127.35	...	...
Division-wide overhead	178,175	178,175	212.03	212.03	...	...	168,448	168,448	207.93	207.93	...	...
Total operating costs	693,632	687,874	825.43	818.58	-16.85	- 2.0	765,258	756,139	944.62	933.37	-11.25	- 1.2
Miscellaneous capital costs	17,781	17,781	21.16	21.16	...	...	17,474	17,474	21.57	21.57	...	...
Imputed rent[c]												
20-year	242,152	161,370	288.16	192.03	-96.13	-33.4	274,344	209,968	338.64	259.18	-79.46	-23.5
30-year	201,604	134,349	239.91	159.88	-80.03	-33.4	228,407	174,810	281.94	215.78	-66.16	-23.5
Total costs under bond period assumption of:												
20 years	953,566	867,026	1,134.75	1,031.77	-102.98	- 9.1	1,057,076	983,581	1,304.83	1,214.12	-90.67	- 7.0
30 years	913,018	840,096	1,086.49	999.72	- 86.77	- 8.0	1,011,139	948,423	1,248.13	1,170.72	-77.41	- 6.2

Note: Details may not add to totals due to rounding.

a/ Less than 0.1%.

b/ Included by Loudoun County schools in division-wide overhead in 1973-74 (see page 55).

c/ Note that this rent is derived using costs per square foot figures and the actual square feet per student ratio for this school. The procedure differs from that used in the cross-sectional analysis. See p. 25 for a detailed explanation.

TABLE 4.4

COSTS OF STERLING MIDDLE SCHOOL ON A MOCK TRADITIONAL AND 45-15 BASIS, 1973-74 AND 1974-75

(Based on an ADM of 1,389.36 in 1973-74 and 1,534.40 in 1974-75)

	1973-74						1974-75					
	Total Costs		Costs Per ADM				Total Costs		Costs Per ADM			
	Mock Traditional	45-15	Mock Traditional	45-15	Difference		Mock Traditional	45-15	Mock Traditional	45-15	Difference	
	$	$	$	$	$	%	$	$	$	$	$	%
Administration at school	184,053	170,284	132.47	122.56	- 9.91	- 7.5	212,834	195,152	138.71	127.18	-11.53	- 8.3
Principal	19,065	19,065	13.72	13.72	...	...	20,978	20,978	13.67	13.67	...	...
Assistant principal	35,844	29,530	25.80	21.25	- 4.55	-17.6	40,944	33,188	26.68	21.63	- 5.05	-18.9
Deans	44,519	39,428	32.04	28.45	- 3.59	-11.2	49,565	43,460	32.30	28.32	- 3.98	-12.3
Counselors	44,398	40,480	31.96	29.14	- 2.55	- 8.0	55,817	50,212	36.38	32.72	- 3.66	10.1
School Nurse	5,938	7,392	4.27	5.32	1.05	24.6	6,653	8,435	4.34	5.50	1.16	26.7
Secretaries	34,290	34,290	24.68	24.68	...	...	38,877	38,877	25.34	25.34	...	...
Instructional salaries	655,895	650,759	472.08	468.39	- 3.69	- 0.8	800,262	786,835	521.55	512.80	- 8.75	- 1.7
Teachers and aides	642,132	635,621	462.18	457.49	- 4.69	- 1.0	769,406	758,667	501.44	494.44	- 7.00	- 1.4
Librarian	9,577	10,953	6.89	7.88	0.99	14.4	26,252	23,564	17.11	15.36	- 1.75	-10.2
Library clerk	4,185	4,185	3.01	3.01	...	...	4,604	4,604	3.00	3.00	...	...
Instructional costs other than salaries	36,765	36,765	26.46	26.46	...	...	29,020	29,020	18.91	18.91	...	...
Utilities and fuel	33,012	28,785	23.76	20.72	- 3.04	-12.8	93,798	74,270	61.12	48.40	-12.72	-20.8
Electricity	28,704	24,477	20.66	17.62	- 3.04	-14.7	88,156	68,628	57.45	44.73	-12.72	-22.1
Other	4,308	4,308	3.10	3.10	...	...	5,642	5,642	3.68	3.68	...	...
Maintenance	47,381	37,586	34.10	27.05	- 7.05	-20.7	45,855	37,761	29.88	24.61	- 5.27	-17.6
Head custodian	7,139	7,139	5.14	5.14	...	...	7,955	7,955	5.18	5.18	...	...
Assistant custodians	35,850	27,127	25.80	19.53	- 6.27	-24.3	25,599	18,879	16.68	12.30	- 4.38	-26.3
Custodial supplies	4,393	3,321	3.16	2.39	- 0.77	-24.4	5,209	3,836	3.39	2.50	- 0.89	-26.3
Other[a]	...	...	...	...	...	...	7,091	7,091	4.62	4.62	...	...
Middle school overhead	30,205	30,205	21.74	21.74	...	...	40,462	40,462	26.37	26.37	...	...
Division-wide overhead	294,586	294,586	212.03	212.03	...	...	319,047	319,047	207.93	207.93	...	...
Total operating costs	1,281,897	1,248,970	922.65	898.95	-23.70	- 2.6	1,541,279	1,482,547	1,004.48	966.21	-38.27	- 3.8
Miscellaneous capital costs	29,399	29,398	21.16	21.16	...	...	33,097	33,097	21.57	21.57	...	...
Imputed rent[b]												
20-year	402,285	304,024	289.55	218.82	-70.73	-24.4	481,213	354,380	313.62	230.96	-82.66	-26.4
30-year	334,934	253,124	241.07	182.19	-58.88	-24.4	400,651	295,052	261.11	192.29	-68.82	-26.4
Total costs under bond period assumption of:												
20 years	1,713,580	1,582,393	1,233.36	1,138.93	-94.43	- 7.7	2,055,589	1,870,024	1,339.67	1,218.74	-120.93	- 9.0
30 years	1,646,230	1,531,493	1,184.88	1,102.30	-82.57	- 7.0	1,975,027	1,810,656	1,287.16	1,180.07	-107.09	- 8.3

Note: Details may not add to totals due to rounding.

a/ Included by Loudoun County in division-wide overhead, 1973-74 (see page 55).

b/ Note that this rent is derived using costs per square foot figures and the actual square feet per student ratio for this school. The procedure differs from that used in the cross-sectional analysis. See p. 25 for a detailed explanation.

the criterion of maintaining the same ratio of contact days between students and a given position. For example, in the 45-15 Sterling M.S., there were 250,084.80 student school days. During this period, there were 450 assistant-principal-contact days. In other words, each assistant principal worked 225 days during which students were attending school. The ratio of assistant-principal-contact days to student days was 0.001799, and this ratio was maintained in the mock school. For 1,050 students 1.89 assistant principals would be required, and for the additional 339.36 students 0.61 assistant principals. Although a school generally employs only full-time assistant principals, to presuppose an easy rounding formula would be a gross oversimplification of a rather difficult central administration decision process. It would introduce arbitrary cost differentials between the two schools being compared. For these reasons, costs were based on fractional numbers of employees.

3. The number of teachers for the mock school are projected to maintain the same student-teacher ratio as that in the 45-15 school. Expenditures for teacher aides are equated.

4. Other costs, such as custodial services and supplies, are based on the square footage they were required to service.

5. Fuel expenditures for the mock school are based on square footage. Electricity expenditures are based on a similar formulation except that summer cooling costs associated with 45-15 are not included in mock-traditional-school-electric-cost estimates. Data on electric consumption in these schools in 1972-73 is used to estimate the difference due to the altered school calendar. (See Appendix on Methodology.)

Summaries of savings derived in tables 4.1 to 4.4 are presented in table 4.5. The percentage savings of the 45-15 school as compared with the mock traditional school are summarized for each of the eight cases in this table. Several of the results merit discussion.

Savings in the elementary schools ranged from 2.0 percent at Guilford in 1974-75 to 9.1 percent at Sully in 1973-74. These extremes are the result of rather unusual circumstances. In both years of the 45-15 plan, the ADM of Guilford was slightly expanded over traditional capacity. Thus the savings at this school were not so large as at other facilities in which 45-15 effected a greater percentage in enrollment. As previously mentioned, Sully was subject to overcrowding in

TABLE 4.5

PERCENTAGE SAVING OF 45-15 OVER TRADITIONAL MOCK SCHOOL OF THE SAME ADM, LOUDOUN COUNTY SCHOOLS, 1973-74 AND 1974-75

School	Percentage Savings 1973-74	1974-75
Guilford Elementary		
20-year bond life	2.9	2.2
30-year bond life	2.4	2.0
Sterling Elementary		
20-year bond life	4.5	4.4
30-year bond life	3.9	3.9
Sully Elementary		
20-year bond life	9.1	7.0
30-year bond life	8.0	6.2
Sterling Middle		
20-year bond life	7.7	9.0
30-year bond life	7.0	8.3

Source: Tables 4.1 to 4.4.

1973-74, and this resulted in greater savings than would be possible under normal circumstances. By expanding its enrollment through 45-15 by approximately 20 percent in each of the two years, Sterling E.S. realized savings in the neighborhood of 4 percent. This figure may be the most credible in this sample since in the two years of 45-15, the school was consistent in attaining this savings. In 1974-75 Sully increased its traditional enrollment by 31 percent, and the cost savings were 6-7 percent. Since theoretically enrollment can expand by 33 percent under 45-15, Sully approximated maximum expansion. Thus the cost savings at Sully in that year represent savings achievable under 45-15 with the best planning or the best fortune, or possibly a combination of the two. In summary, the savings appear to be in the 4-6 percent range for elementary schools in Loudoun County under 45-15.

The savings for Sterling M.S. were in the 7-9 percent range. Savings at the middle school level under 45-15 were higher for several reasons. First, with many administrative personnel on extended contract, additional days of service did not have to be purchased under 45-15. Second, teachers

could opt for extended contracts, thereby saving additional fixed fringe benefit costs associated with employing new teachers. In addition, 45-15 scheduling at the middle school promoted maximum usage of the middle school buildings. For example, in both years of 45-15, Sterling increased its ADM by approximately 33 percent.

In chapter 3 a cross-sectional comparison was made of educational costs in 45-15 and traditional schools. Table 3.10 summarized the statistics. Elementary school savings ranged from 3.2 to 12.9 percent, while average savings were in the neighborhood of 7-8 percent. Middle school savings ranged from 9.9 to 19.7 percent. As noted in chapter 3, the most realistic middle school comparison revealed savings in the 9.9-13.4 percent range.

It is evident from the foregoing discussion that greater savings are projected by the cross-sectional analysis than the mock-school analysis. This is to be expected, since by the nature of the data available comparisons are made between schools of significantly different size. Discussion of size-cost relationship in this report has shown that economies of scale result in lower per student costs in larger facilities. While cross-sectional comparisons were between large 45-15 schools and smaller traditional schools; the mock-school comparison was between schools of identical ADM. In fact, in terms of square footage the mock traditional school represents a larger facility than the 45-15 school for which the comparison is developed. Therefore, in view of the positive size-cost relationship the relative values of the savings estimated in chapter 3 and 4 are compatible.

In summary, two conceptually different approaches to cost comparisons under traditional and 45-15 schedules show savings under 45-15. In addition, the cost savings estimates for the alternative model designs are logically consistent. Another important finding is that savings are likely to be higher in a 45-15 middle school than at the elementary school level.

CHAPTER 5

START-UP COSTS ANALYSIS

Start-up costs, as defined in this study, include all special one-time costs related to the organization, operation, and evaluation of the Loudoun 45-15 year-round school program that would not have been incurred had the program not been adopted.

Lack of precise data made the isolation of these costs difficult. For example, while it was easy to determine the capital cost of air-conditioning two of the 45-15 pilot schools, it was difficult to ascertain the central office personnel costs incurred to plan, operate, and evaluate the 45-15 program. Likewise, certain judgments were made regarding the general costs of planning and implementing the 45-15 program.

In 1973-74 $355,530 was spent to air-condition Guilford and Sully schools. The magnitude of this expenditure relative to total start-up costs (74.9 percent) warrants comment. First, all new schools in Loudoun County are now air-conditioned; hence, had Guilford and Sully been built as recently as Rolling Ridge or Sugarland, no additional cost would have been incurred. Second, because the air-conditioning was a capital cost, and because the benefits were not limited to the terminated year-round program, this cost should probably be spread over many years. Using a 10-year period at 6 percent, the yearly cost would be $48,317; over 20 years, the period of the bond issue used to finance the air-conditioning of Guilford and Sully, it would be $30,967; and over 30 years it would be $25,811.

Start-up costs for personnel are limited to the proportionate cost of central office personnel time devoted to the planning, operation, and evaluation of the 45-15 program. These proportions were determined by the planning staff of the school division. Personnel costs for directing 45-15 were assumed to be one-time costs until the program was operating smoothly; thereafter all such coordinating costs would become part of the regular supervisory program and expenditure.

Certain general costs of planning and implementing the 45-15 program classified as start-up costs include the purchase of materials from other 45-15 systems, visitations to other 45-15 programs, certain in-service costs, and related miscellaneous expenses.

Certain costs are specifically excluded from the category of start-up costs, even though they were covered by a special 45-15 grant from the State Department of Education; the functions they provided were not inherent to the elementary and middle school 45-15 system and/or would have been carried on without the grant. Examples include planning costs involved in reorganizing the curriculum, the scheduling of bus routes, and similar activities. Even though developing the curriculum in 45-day modules was necessary to the 45-15 plan, the 45-15 curriculum guides were used in all county schools, including the traditional schools. In addition, curriculum revision is an ongoing process and must be conducted on a regular basis.

Estimated start-up costs for 1971-72 through 1974-75 were $474,626. This figure includes $113,063 in personnel-related expenditures, $6,034 in general expenditures, and $355,530 in capital expenditures. A specific breakdown of these costs by year is found in table 5.1. As noted in the section on capital (air-conditioning) costs, it seems reasonable to spread the total start-up costs over several years, as would be readily apparent had the program not been terminated and had instead become part of the regular program. Over ten years at 6 percent, the annual layout for start-up costs would be $64,502.

TABLE 5.1

LOUDOUN COUNTY START-UP COSTS, 1971-72 TO 1974-75

Costs	1971-72	1972-73	1973-74	1974-75	Total
Personnel	$	$53,808.82[a/]	$24,261.69[b/]	$34,992.34[c/]	$113,062.85
General	318.00	5,715.37			6,033.57
Total Operating	318.00	59,524.39	24,261.69	34,992.34	119,096.42
Capital			355,530.00		355,530.00
Total	318.00	59,524.39	379,791.69	34,992.34	474,626.42

a/ Includes personnel expenditures for time necessary for development (84%) and evaluation (16%).

b/ Includes personnel expenditures for time necessary for development (8%), operation (36%), and evaluation (56%).

c/ Includes personnel expenditures for time necessary for operation (20%) and evaluation (80%).

CHAPTER 6

CONCLUSIONS

In this chapter the results of the Loudoun County 45-15 study are compared with those of other studies, and conclusions based on the Loudoun findings are presented.

Comparison with Other Studies

Valley View.--Because of the research design, the Illinois State Superintendent's Office study of the Valley View experience cannot be used for a comparison.1/ However, a H.E.W. report evaluated 45-15 cost savings in this same system. Certain "conjectures" were used to develop projections of costs had the district converted to 45-15. This study estimated a 4.1 percent district-wide average savings in per pupil costs under the 45-15 mode of operation. Savings at the individual school levels were not evaluated.

The estimated cost savings of 4.1 percent in the H.E.W. Valley View study is consistent with the Loudoun County results. In chapter 4 of this study, the mock-school analysis indicated a 4-6 percent savings in the elementary 45-15 schools and a 7-9 percent savings in the 45-15 middle school. Given the imprecision of the estimating procedure used in the H.E.W. study, it is fairly consistent with the Loudoun results.

Virginia Beach.--The Institute for Social Analysis study was a cross-sectional cost comparison between the 45-15 elementary schools and the traditional elementary schools in the Virginia Beach division. The study revealed that a small savings occurred in the 45-15 schools. However, the report emphasized that these savings were relatively insignificant. Several procedural differences between the Virginia Beach study and the Loudoun County study account for the diverse nature of the findings.

1/ See chapter 2 for a discussion of this point.

1. The Virginia Beach study did not standardize for class-size differences. Because the 45-15 schools had a smaller student-teacher ratio than the traditional schools, the per student instructional salaries were significantly higher in the 45-15 schools. This result is in sharp contrast with the Loudoun County findings in the instructional costs category. In this study the cost figures are standardized for differences in class size, and the 45-15 schools experience a small per student cost savings in this category.

2. In the Virginia Beach study, textbook costs were higher in 45-15 schools than in the traditional schools. This is a rather unusual finding and varies from the Loudoun County findings in this cost category.

3. In the Loudoun County study, start-up costs associated with the transition to the 45-15 calendar are evaluated separately. In the Virginia Beach study these costs were included in the comparative figures; no distinction was made between these one-time start-up expenditures and the recurring costs of 45-15 schooling. Neither procedure is necessarily incorrect. However, in the Loudoun County study, these costs are evaluated separately. The two major costs were administration and air-conditioning, and in both cases it was unclear as to what fraction of these costs were related to the 45-15 program. For example, benefits from air-conditioning accrue in June and September of a regular school year, and so some percentage of air-conditioning costs would occur under the traditional calendar. In addition, it was unclear as to how many years the start-up costs should be spread over.

These methodological differences are largely responsible for the incomparability of the findings in these studies.

Prince William.--In the Education Turnkey Systems study of Prince William County, the elementary schools operated at a 5.2 percent savings over the mock traditional schools. The middle school saving was 9.6 percent.

These estimates are consistent with the results of the Loudoun County study. In each case the Turnkey estimates are slightly higher. One explanation is that the mock traditional schools in the two studies were developed for different ADMs. The Turnkey mock traditional school was based on an ADM of 1,050, whereas the 45-15 school ADM was 1,400.1/ Using an alternative procedure, the Loudoun County study used a mock

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1/ According to a telephone conversation with Mr. John Sweeney of Education Turnkey Systems, March 16, 1976.

traditional school with an ADM equal to that in the 45-15 school. Therefore, given the same ADM under 45-15, the mock traditional school using the Turnkey procedure would be smaller than the mock school using the Loudoun County procedure.1/ For this reason, certain economies of scale associated with the larger mock facility in the Loudoun County study result in lower estimated cost savings.

Conclusions

The evidence presented in this report indicates a cost savings under 45-15. The magnitude of the cost savings estimates is consistent with the results of other 45-15 cost studies. In this report, both the cross-sectional and the mock traditional school models are used in developing cost comparisons. The cross-sectional model yields higher estimates of cost savings, but a significant fraction of these savings is related to school size.

The mock-school comparison indicated a 4.0-6.0 percent cost savings in the elementary schools and a 7.0-9.0 percent cost savings in the middle school. In table 6.1, these savings are categorized for Sterling E.S., the elementary school with midrange savings, and for Sterling M.S. (A negative sign indicates a negative savings in that category.)

The major category of savings was in imputed rent; the reason is the greater utilization of buildings under 45-15. Imputed rent accounted for 89-94 percent of the savings at Sterling E.S. and for 64-75 percent of the savings at Sterling M.S. Administration showed negative savings (extra costs under 45-15) at the elementary school but positive savings at the middle school. Instructional salaries showed negative savings the first year at Sterling E.S. but positive savings the second year and for both years at Sterling M.S. Instructional costs other than salaries, elementary/middle school overhead, division-wide overhead, and miscellaneous capital costs showed zero savings. Relatively small percentages of total savings were accounted for by utilities and fuel and maintenance.

1/ The Turnkey study assumed that the 45-15 school would have a one-third greater ADM. Therefore, since ADM under 45-15 was 1,400, ADM at the mock traditional school was assumed to be 1,050. The Loudoun study used the same ADM for both modes of operation. The difference between 45-15 ADM and existing capacity ADM under traditional operation was accounted for by assuming a proportionate increase in the size of the school building.

TABLE 6.1

PERCENTAGE OF TOTAL 45-15 COST SAVINGS UNDER MOCK SCHOOL ANALYSIS BY COST CATEGORY FOR STERLING ELEMENTARY SCHOOL AND STERLING MIDDLE SCHOOL, 1973-74 AND 1974-75

	Percent of 45-15 Savings Under Bond Period Shown			
	1973-74		1974-75	
	20 Years	30 Years	20 Years	30 Years
Sterling Elementary School				
Administration at school	- 4.9	- 5.8	- 4.9	- 5.7
Instructional salaries	- 3.4	- 4.1	1.1	1.3
Instructional costs other than salaries	...	...	...	...
Utilities and fuel	9.0	10.6	8.2	9.6
Maintenance	5.9	7.0	4.9	5.8
Elementary school overhead	...	...	...	...
Division-wide overhead	...	...	...	...
Miscellaneous capital costs	...	...	...	...
Imputed rent	93.5	92.3	90.7	89.0
Total	100.0	100.0	100.0	100.0
Sterling Middle School				
Administration at school	10.5	12.0	9.5	10.8
Instructional salaries	3.9	4.5	7.2	8.2
Instructional costs other than salaries	...	...	...	...
Utilities and fuel	3.2	3.7	10.5	11.9
Maintenance	7.5	8.5	4.4	4.9
Middle school overhead	...	...	...	...
Division-wide overhead	...	...	...	...
Miscellaneous capital costs	...	...	...	...
Imputed rent	74.9	71.2	68.4	64.3
Total	100.0	100.0	100.0	100.0

Note: Details may not add to totals due to rounding.

Source: Tables 4.2 and 4.4.

Start-up costs evaluated in chapter 5, would require the annual expenditure of $64,502 over a 10 year period.1/ This would translate into a per student cost of $17.51 per year, which represents roughly 1.5 percent of total per student educational costs.2/ Therefore, the savings over the 10-year transitional period would be 3.5-4.5 percent in the elementary schools and 5.5-7.5 percent in the middle school. After the transitional period savings would move to the 4.0-6.0 percent and 7.0-9.0 percent levels.

Total cost savings as distinct from per student savings can be found by subtracting total 45-15 costs from mock traditional costs in tables 4.1-4.4. The figures developed cover each year of operation and the two bond period assumptions used to derive imputed rent. In 1973-74 total cost savings were $280,766 based on the 20-year-bond assumption and $240,201 based on the 30-year-bond assumption. (See table 6.2.) In 1974-75 savings were $327,619 under the 20-year-bond assumption and $286,694 under the 30-year-bond assumption. Even after allowance for start-up costs (estimated to be $64,502 annually for ten years in chapter 5), the total cost savings were substantial.

1/ Note that this figure is a maximum start-up cost and probably overstates this cost. See chapter 5 for a discussion of this point.

2/ Derived by dividing $64,502 by the average total 45-15 division-wide ADM over the 1973-74 and 1974-75 period.

TABLE 6.2

TOTAL COST SAVINGS OF LOUDOUN COUNTY 45-15 SCHOOLS BASED ON A MOCK SCHOOL ANALYSIS, 1973-74 AND 1974-75

School and Bond Period Assumption	Total Cost Savings 1973-74	1974-75
20-year bond period		
Guilford E.S.	$ 19,896	$ 18,254
Sterling E.S.	43,143	50,305
Sully E.S.	86,540	73,495
Sterling M.S.	131,187	185,565
	280,766	327,619
30-year bond period		
Guilford E.S.	16,153	15,939
Sterling E.S.	36,389	42,668
Sully E.S.	72,922	62,716
Sterling M.S.	114,737	164,371
	240,201	286,694

Sources: Tables 4.1 to 4.4.

APPENDIX ON METHODOLOGY

This appendix includes a detailed outline of operating-cost categories; a procedure for allocating custodial supply costs to cost centers; a method for determining electrical cost data; a rationale for ignoring cafeteria costs; and the development of imputed rent.

Operating-Cost Categories

The seven operating-cost categories outlined below show the components of each of the categories.

I. Administration at the school level
   - A. Principal's salary
   - B. Assistant principals' salaries
   - C. Deans' salaries
   - D. Counselors' salaries
   - E. School nurse's salary
   - F. School secretaries' salaries

II. Instructional salaries
   - A. Teachers' salaries
   - B. Teacher aides' salaries
   - C. Librarian's salary (a fraction if shared)
   - D. Library clerk's salary (a fraction if shared)

III. Instructional costs other than salaries
   - A. Instructional supplies
   - B. Library books, supplies, and periodicals
   - C. Medical and dental supplies

IV. Utilities and fuel
   - A. Electricity
   - B. Fuel
   - C. Telephone services
   - D. Water and sewerage services

V. Maintenance
   A. Custodial salaries
   B. Custodial supplies
   C. Repair and replacement of equipment[1/]
   D. Contracted services[1/]
   E. Contracted buildings[1/]
   F. Building maintenance materials[1/]
   G. Contracted equipment[1/]

VI. Elementary/middle school overhead
   A. Supervision and administrative costs specific to elementary/middle school program
   B. Costs of special programs at elementary school level
      1. Music program
      2. Physical education program

VII. Division-wide overhead
   A. Central administration personnel cost
   B. Special program costs applicable to all students
   C. Building and maintenance costs for administration buildings or those not allocated on a per school basis
   D. Transportation costs
   E. Other systemwide costs (e.g., computer center)

Custodial Supplies

The costs for custodial supplies were not recorded by Loudoun County schools at the school level. Rather, they were distributed from a central location, and data were kept on a division-wide basis. The following procedure is used to allocate these costs to the individual schools.

A memo dated November 12, 1975, from the Loudoun County central office used data on the quantity of custodial supplies used at each school to calculate the 1975 dollar price of custodial supplies used at two middle schools and five elementary schools. From these data two inferences were made. First, it was evident that 45-15 schools required no more maintenance dollars per square foot than the traditional schools. In fact, for Sterling M.S., custodial supply expenditures were reduced in the first year of 45-15 operations. Second, two ratios were derived expressing per square foot costs of custodial supplies for both elementary and middle schools.

1/ Included by Loudoun County schools in division-wide overhead in 1973-74.

Total district expenditures for custodial supplies dropped considerably between 1973-74 and 1974-75, presumably because of discontinuities in purchases. The average real cost of custodial supplies was calculated and converted into that year's dollars. Then the previously derived ratios of square foot costs were used to allocate these costs to all of the middle schools and elementary schools based on the ratios of these costs. Stated mathematically, the following algebraic equation is solved for the unknown *X*:

$$\left[(SFE) \cdot X \right] + \left[(SFMS + SFHS + SFO) \cdot R \cdot X \right] = TCSC$$

where:
- *SFE* = square feet in the elementary schools
- *X* = square foot costs of custodial supplies for the elementary schools
- *SFMS* = square feet in the middle schools
- *SFHS* = square feet in the high schools
- *SFO* = square feet in the other educational facilities
- *R* = ratio of middle school per square foot costs to elementary per square foot costs. (It was assumed that middle school per square foot costs were the same as high school and other facility per square foot costs.)
- *TCSC* = total custodial supply costs

From this *X* and $R \cdot X$ can be used to calculate the cost of custodial supplies for any elementary or middle school given the total square feet in the facility.

Electricity data

In order to determine electrical costs for the mock traditional school in chapter 4, summer savings for the traditional school had to be estimated. The following procedure was used. For the four 45-15 schools kilowatt-hour (kwh) data on summer electrical consumption for 1972-73 and 1973-74 were collected. In 1972-73, these schools were on a traditional summer calendar, and in 1973-74 they were operating on a 45-15 schedule. The summer period included 70 days, from June 14 to August 21. The per square foot kwh savings for this period were calculated for each school. These per-square-foot-savings figures were then averaged. To determine the summer period kwh savings in each school, this average was multiplied by each school's square footage. If it is assumed that weather and consumption patterns were fairly similar in the two years, this figure represents the difference in summer electricity usage between traditional and 45-15 operations of this school. To convert these amounts to dollar savings, they were multiplied by price per kwh.

Cafeteria

The school lunch program is autonomously operated at the individual school level. The principal of each school is responsible for the management of its program. Each month a report of debits and credits is filed with the central office. These monthly reports were summed to be evaluated by the school. The figures indicate that 45-15 schools follow the pattern of other schools; accordingly, 45-15 day cafeteria programs should not differ from the traditional programs in net costs. Therefore these costs were not included in the individual school cost analysis.

Imputed rent

In developing the imputed rent estimates, the cost of land acquisition and the foregone property taxes on this land were not included in the estimate. The accuracy of the imputed rent does not merit inclusion of these relatively small costs. The following example demonstrates the small magnitude of property tax foregone for a site of 20 acres. (An elementary school must have 15 acres.) Based on a full value assessment of $5,000 an acre, the property would be valued at $100,000, and the annual foregone tax receipts would be $850 a year at Loudoun's effective tax rate of $0.85 per $100 of market value.1/ Given the imprecision of the imputed rent figures and the uncertainties of property valuation and alternative property use, this component of costs is ignored in this study.

Furthermore the magnitude of these costs cannot be precisely identified. An accurate cost cannot be derived because too much uncertainty exists about the alternative use of the land. In fact, an argument could be made that the positive externalities associated with a neighborhood school increase property values in the area to such a degree that net property tax receipts would increase after the construction of a school. Land acquisition costs are frequently zero because developers often donate the land for school construction, partly because of these positive externalities.

1/ Department of Taxation, 1973 Virginia Assessment/Sales Ratio Study (Richmond: Department of Taxation, 1975), p. 23.

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